Bias Estimation of Biological Reference Points Under Two-Parameter SRRs

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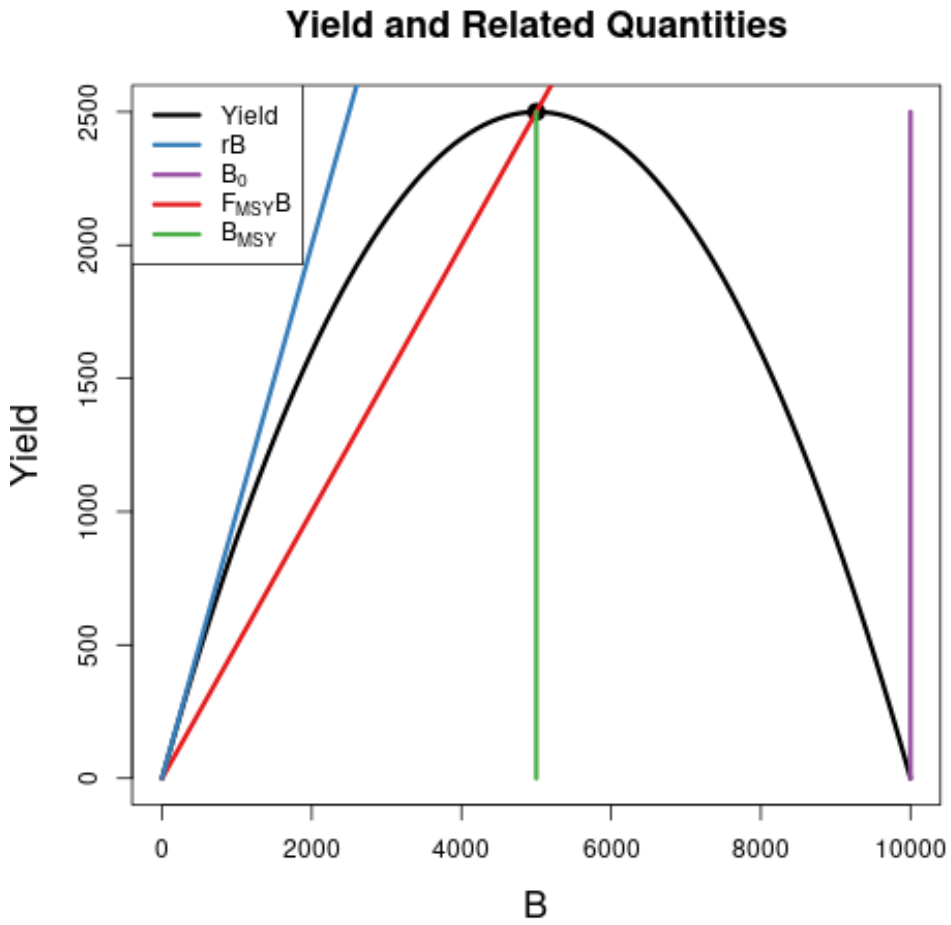
$$I_t = qB_t e^{\epsilon} \quad \epsilon \sim N(0, \sigma^2)$$

$$\frac{dB(t)}{dt} = P(B(t); \boldsymbol{\theta}) - Z(t)B(t)$$

$$RP : MSY, \ \frac{F_{MSY}}{M}, \ \frac{B_{MSY}}{B_0}$$

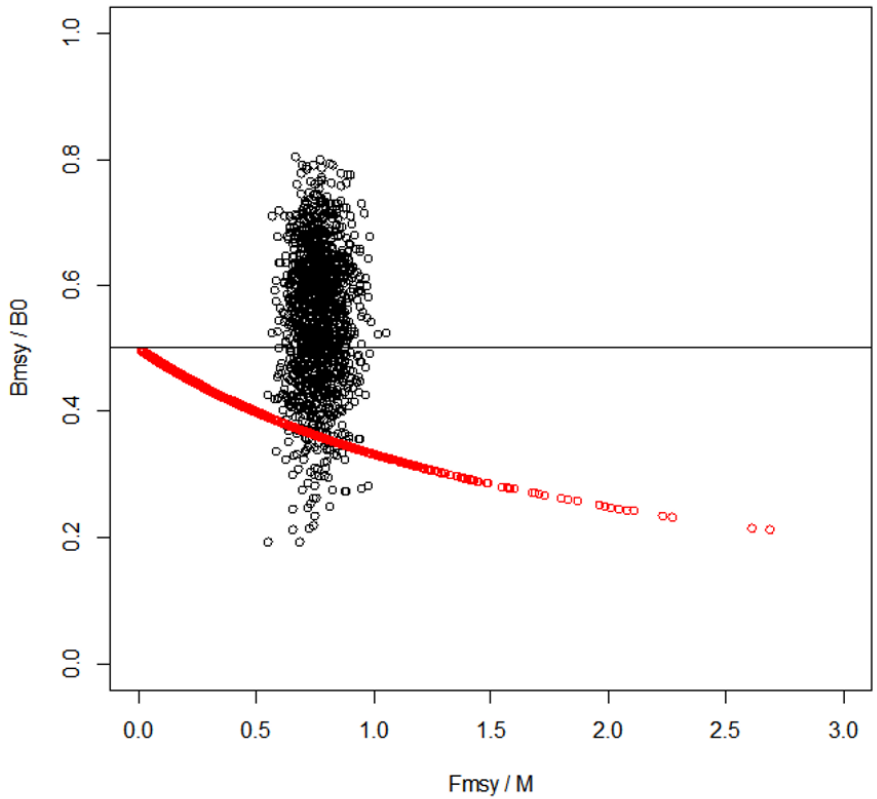


Conceptually:

$$\frac{F_{MSY}}{M} \in \mathbb{R}^{+} \quad \frac{B_{MSY}}{B_0} \in (0,1)$$

Mangel et al. 2013, CJFAS:

- BH Model:
  $F_{MSY} \in \mathbb{R}^{+} \quad \frac{B_{MSY}}{\bar{B}(0)} = \frac{1}{F_{MSY}/M+2}$
- Similar Constraints for other Two-Parameter Curves



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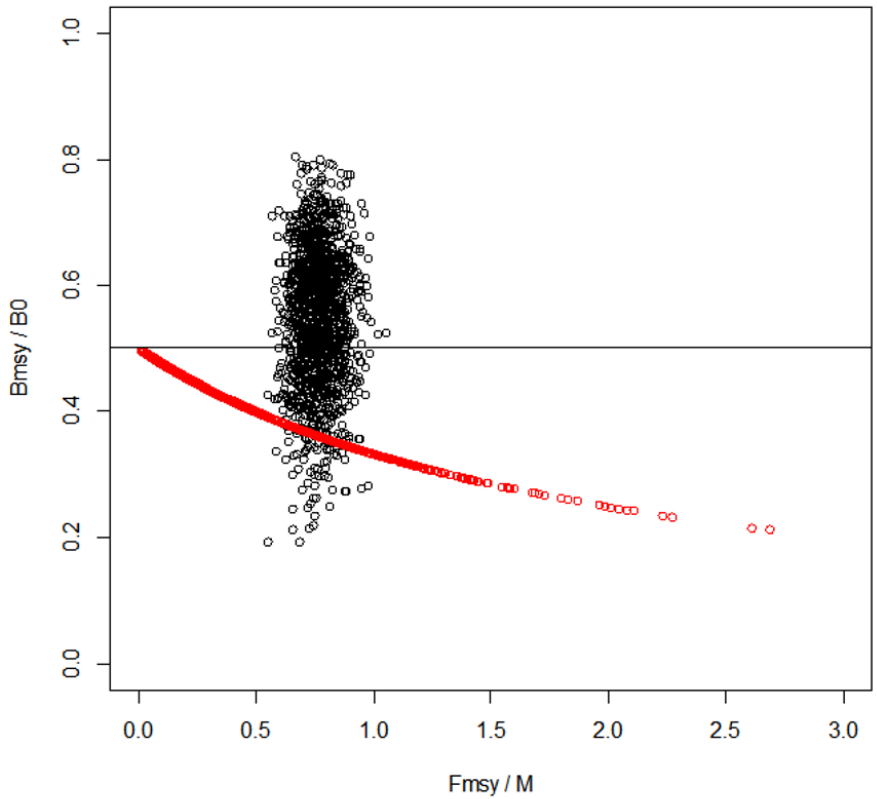
- Similar Constraints for other Two-Parameter Curves
- Three-Parameter Relationships Allow Independent RP Estimation



- Starting from the rock bottom to build understanding
- And analysis of biases for the Scheaffer model can be seen here
- Attacking this problem from the ground up working towards age structred models is important due to the many computational issues that can arrise in ode modeling.
  - chaos
  - time integration error
  - estimation error
  - etc., etc.

Schaefer Analysis

https://ggle.io/5EnI

Schnute 1985, CJFAS

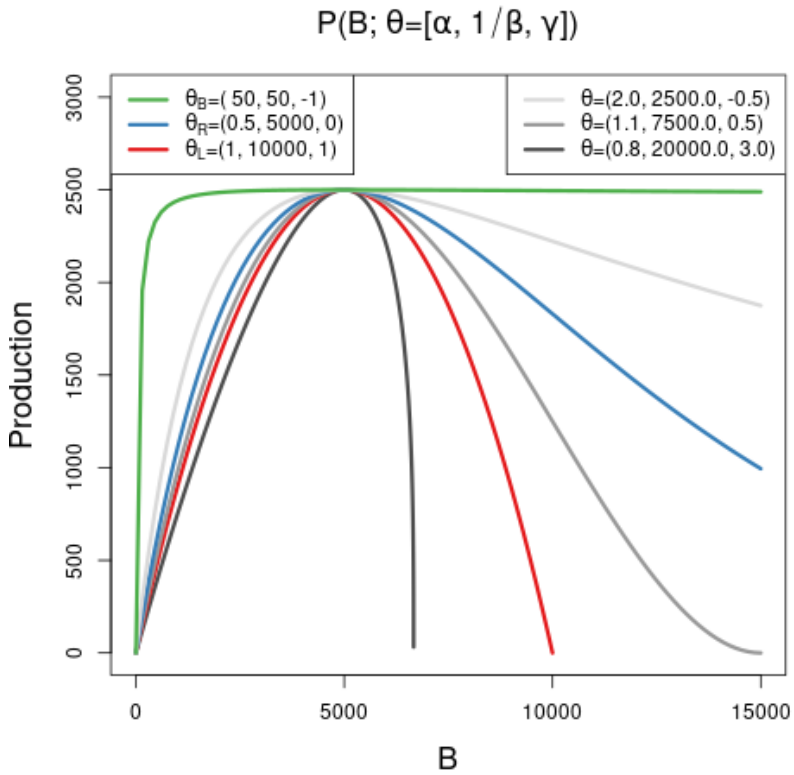
$$\frac{dB}{dt} = P(B;\boldsymbol{\theta}) - (M+F)B$$

$$P(B;[\alpha,\beta,\gamma]) = \alpha B(1-\beta\gamma B)^{\frac{1}{\gamma}}$$

$\gamma = -1 \Rightarrow$ Beverton-Holt

$\gamma \to 0 \Rightarrow$ Ricker

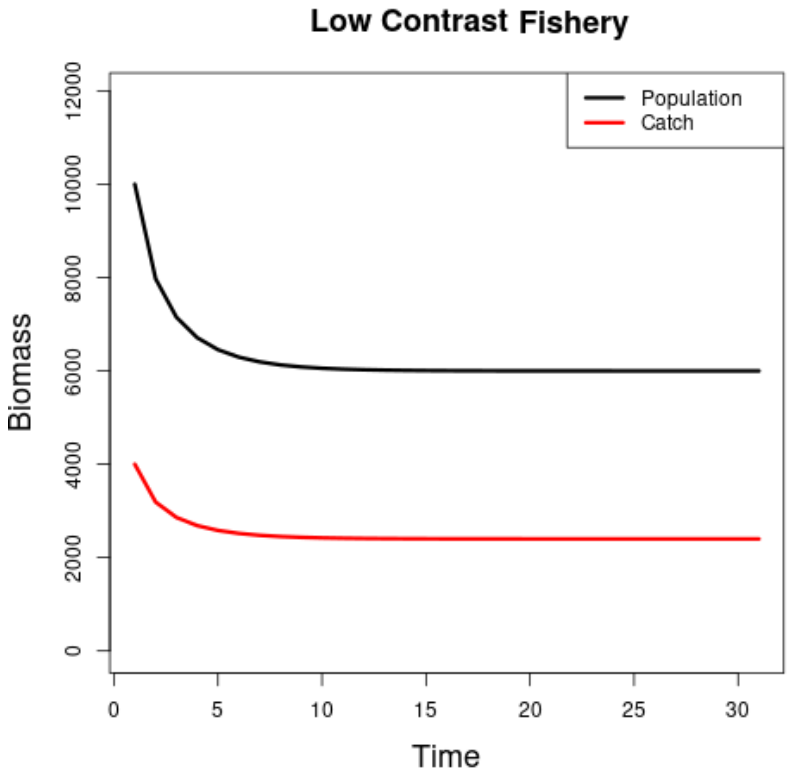
$\gamma = 1 \Rightarrow$ Logistic

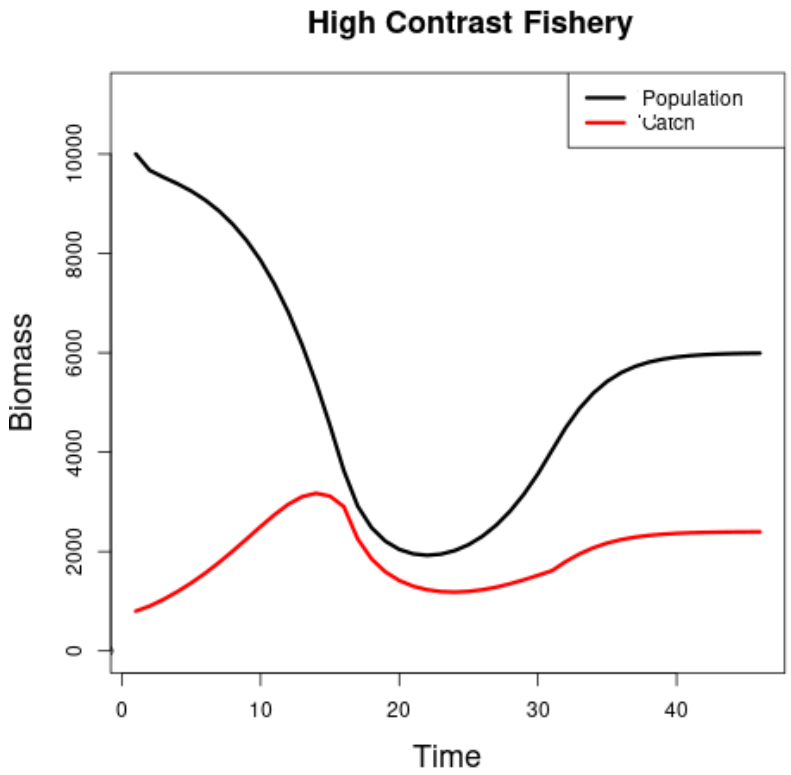


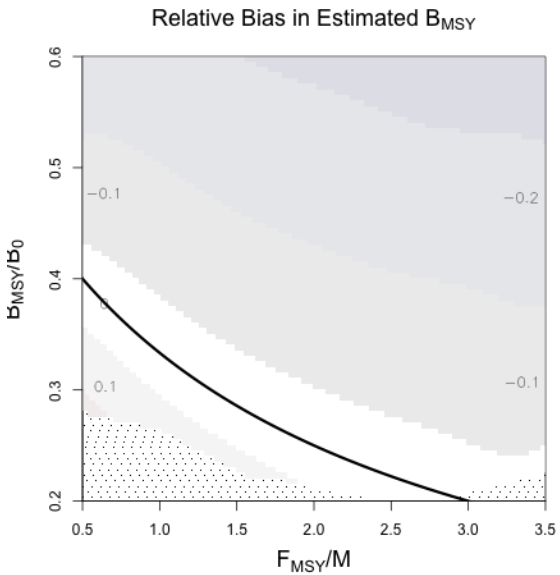
Introish Ideas list

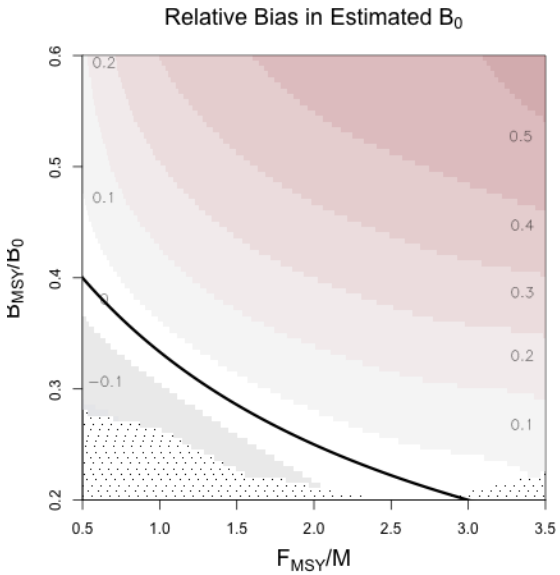
- PT/Schaffer work (link)
- Computational Difficulties
- Schnute Space Filling
- Catch/Contrast

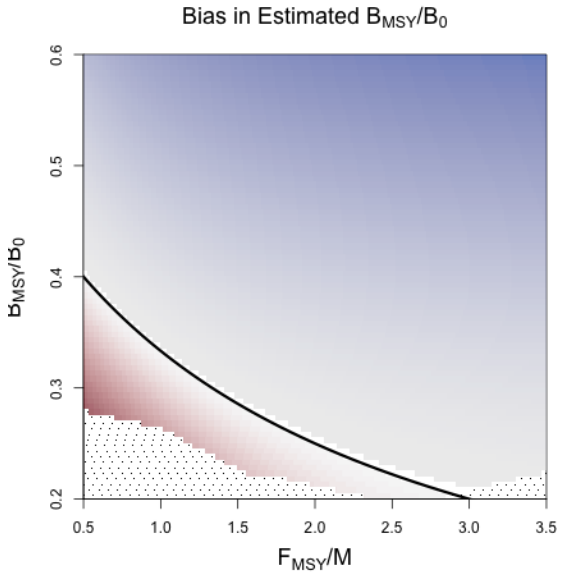
Catch

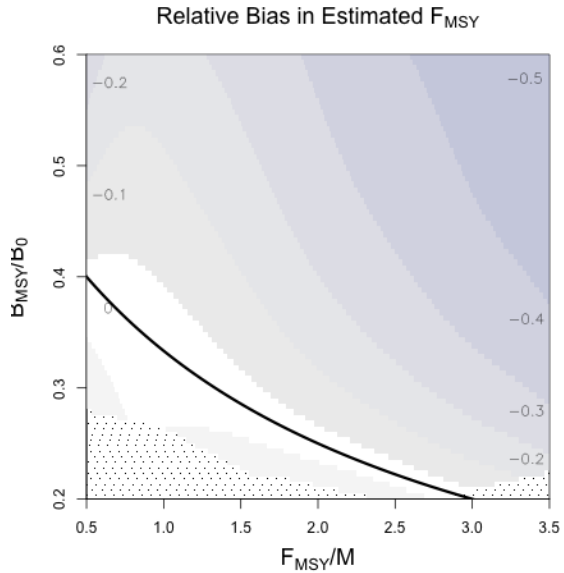

Low Contrast Fishery
Population
Catch
Biomass
0
2000
4000
6000
8000
10000
12000
0
5
10
15
20
25
30
Time


High Contrast Fishery
Population
Catch
Biomass
0
2000
4000
6000
8000
10000
0
10
20
30
40
Time

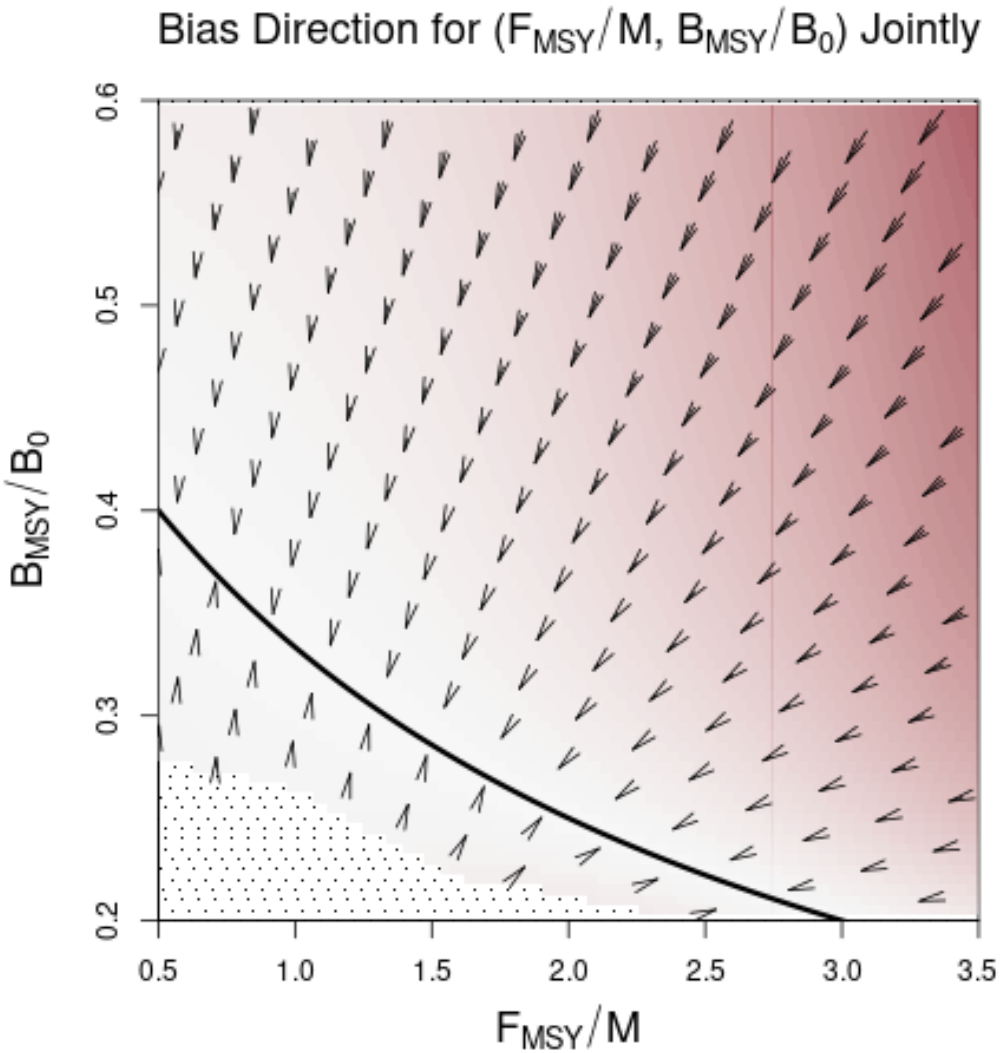

Relative Bias in Estimated B_{MSY}
B_{MSY}/B_0
F_{MSY}/M
−0.1
−0.2
0
0.1


Relative Bias in Estimated B_0
B_{MSY}/B_0
F_{MSY}/M
0.2
0.5
0.1
0.4
0.3
0
−0.1

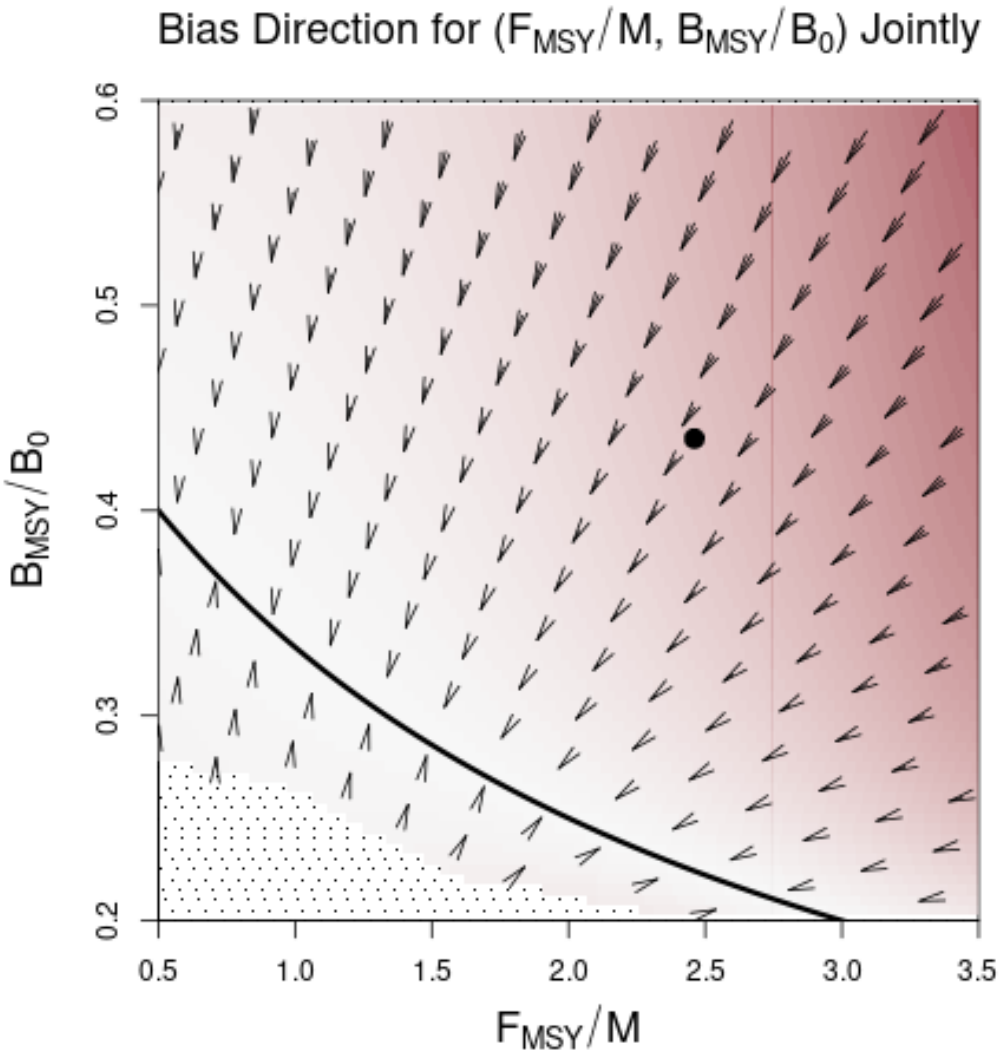

Bias in Estimated B_{MSY}/B_0
B_{MSY}/B_0
F_{MSY}/M

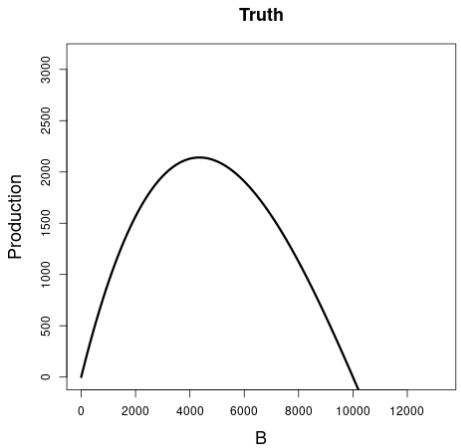

Relative Bias in Estimated F_{MSY}
B_{MSY}/B_0
F_{MSY}/M
−0.2
−0.5
−0.1
0
−0.4
−0.3
−0.2

High Contrast



High Contrast





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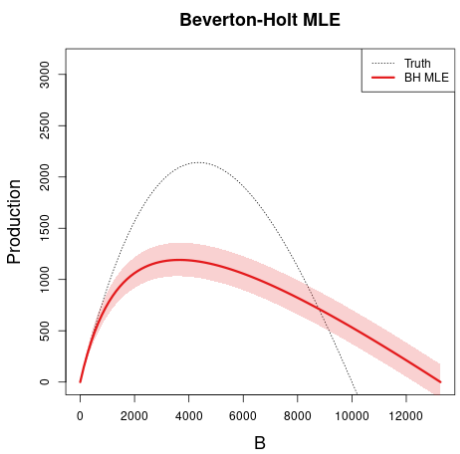

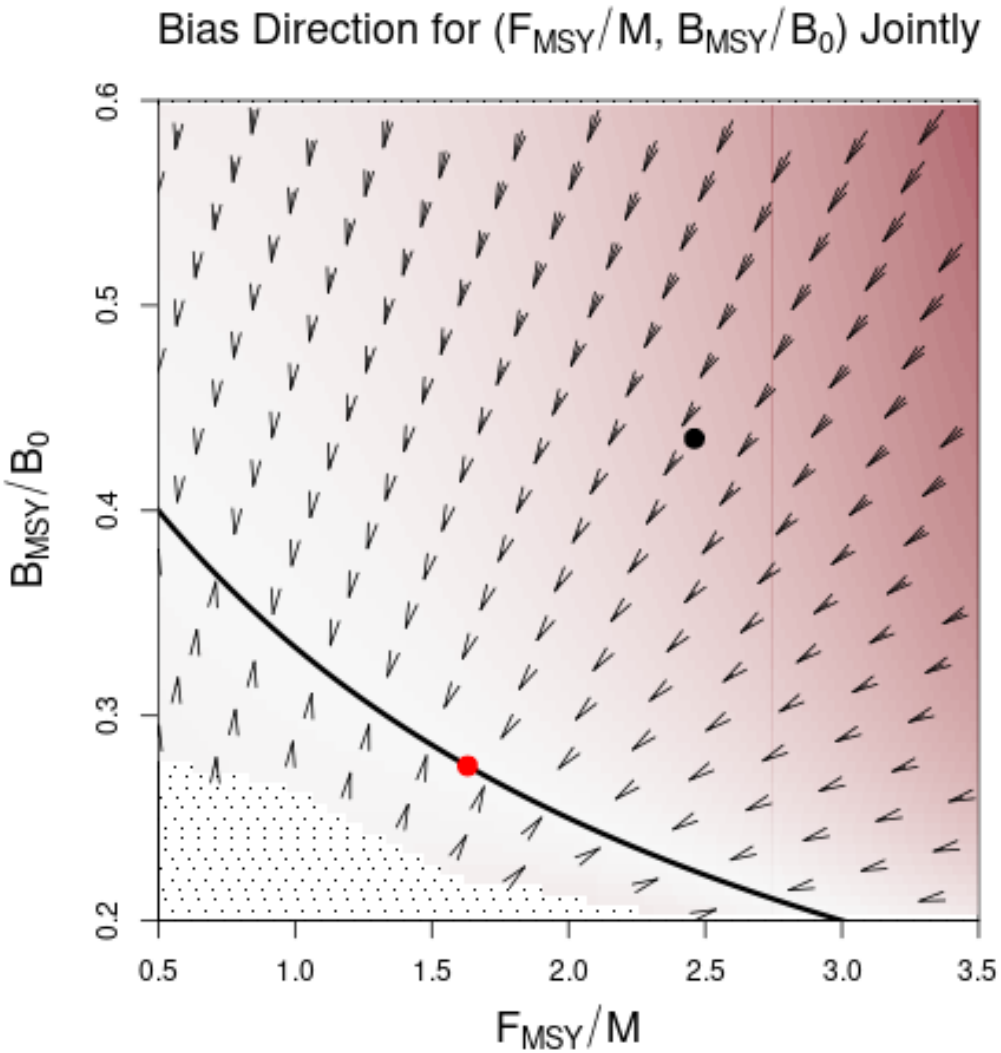

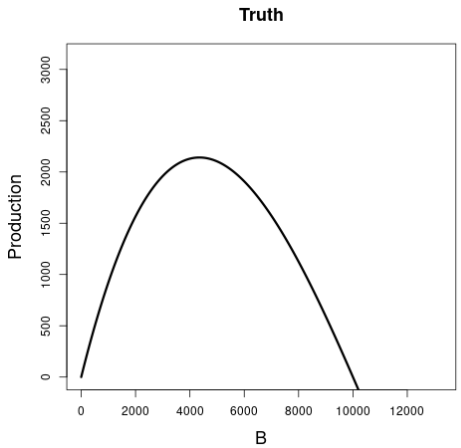

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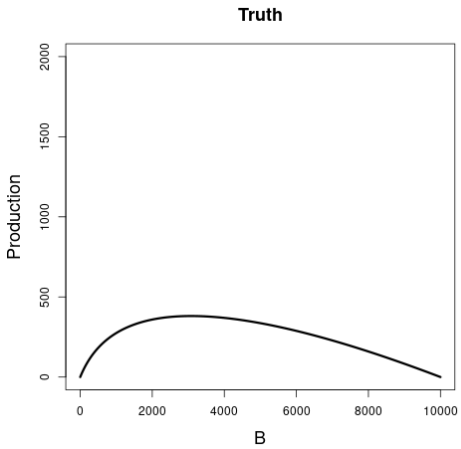

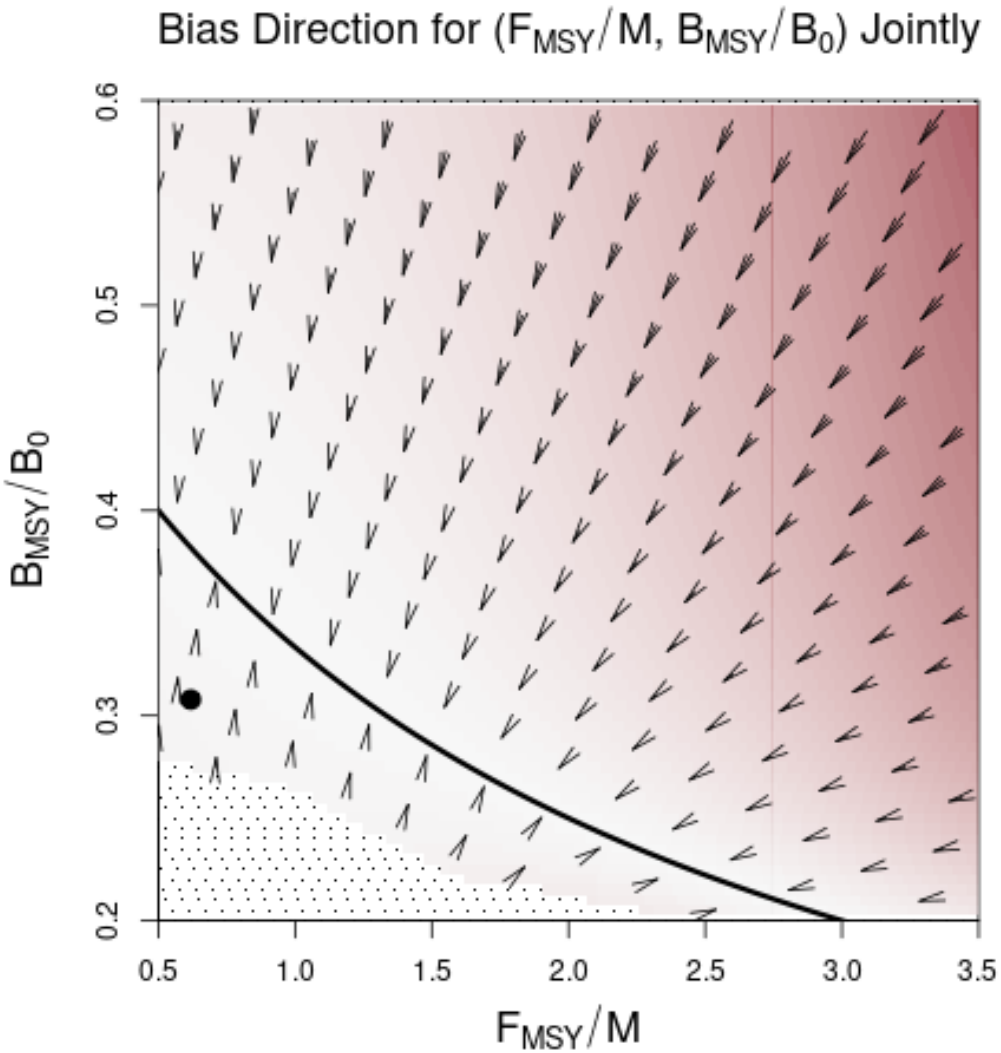

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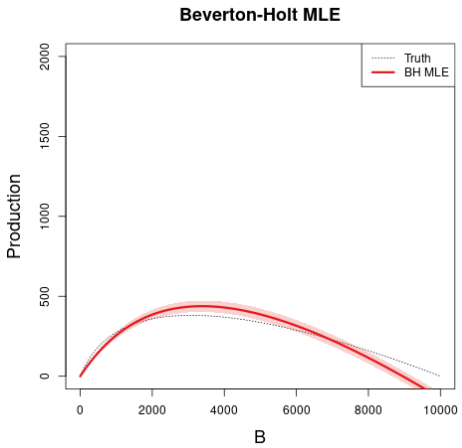
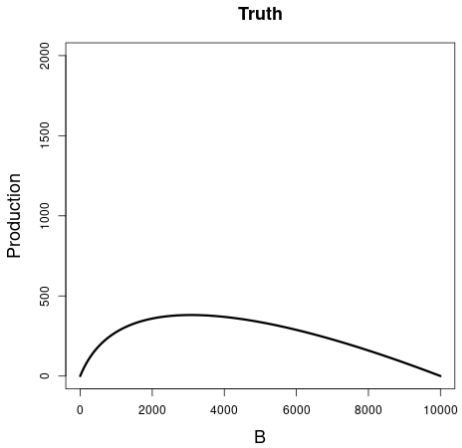
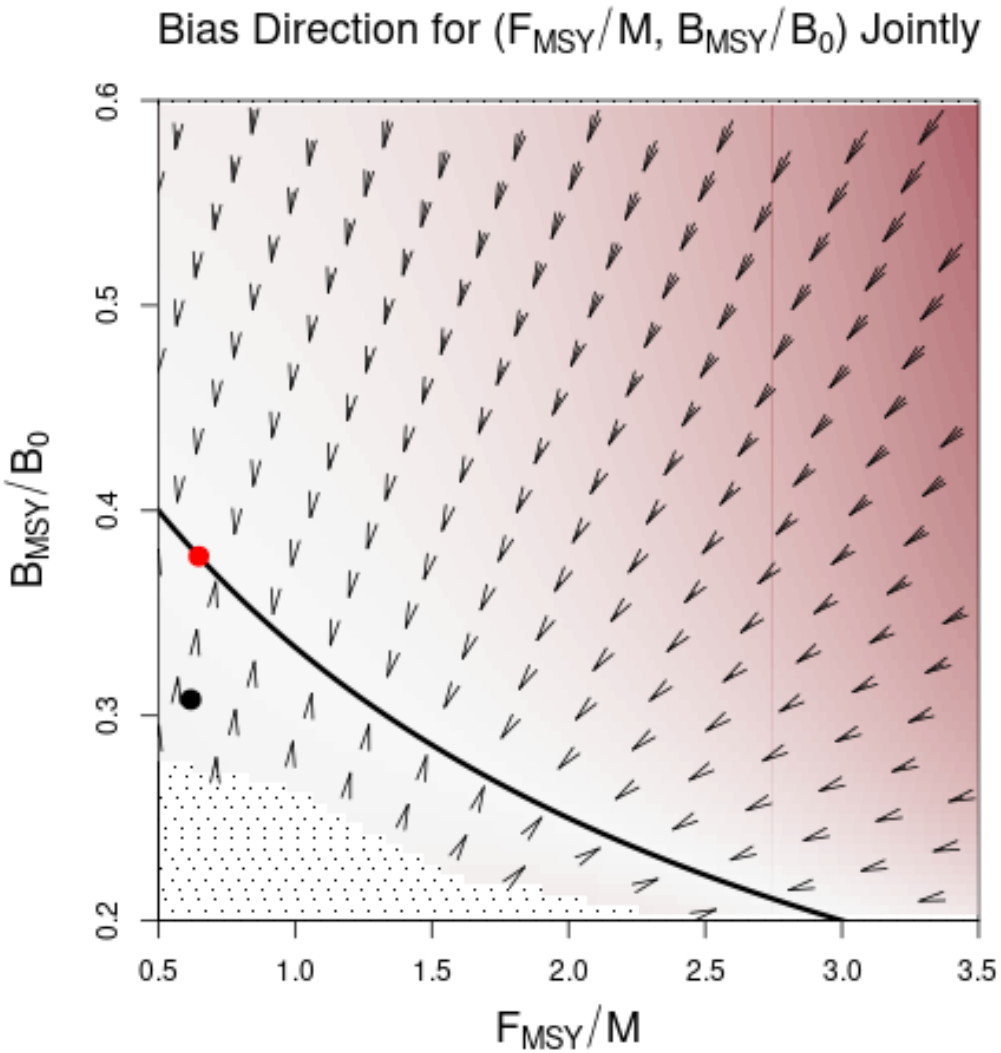
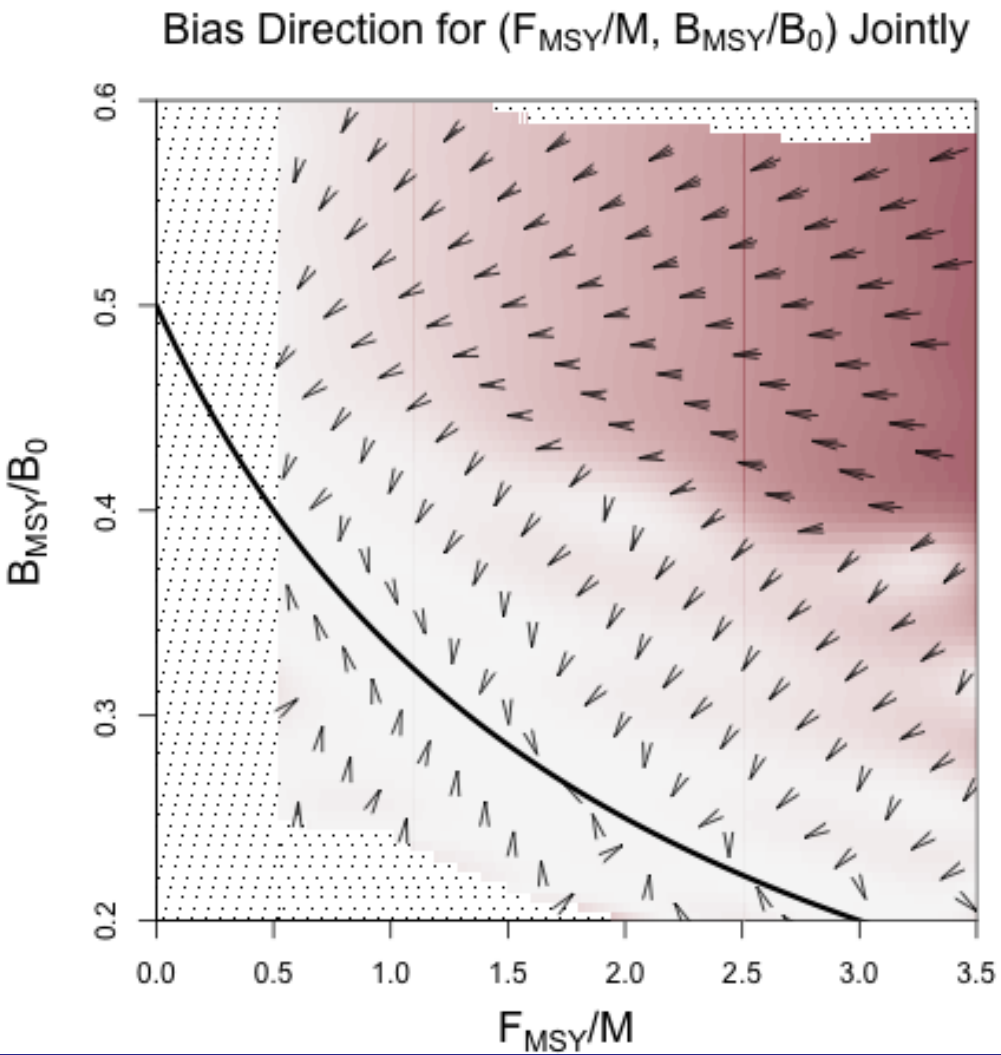






Low Contrast



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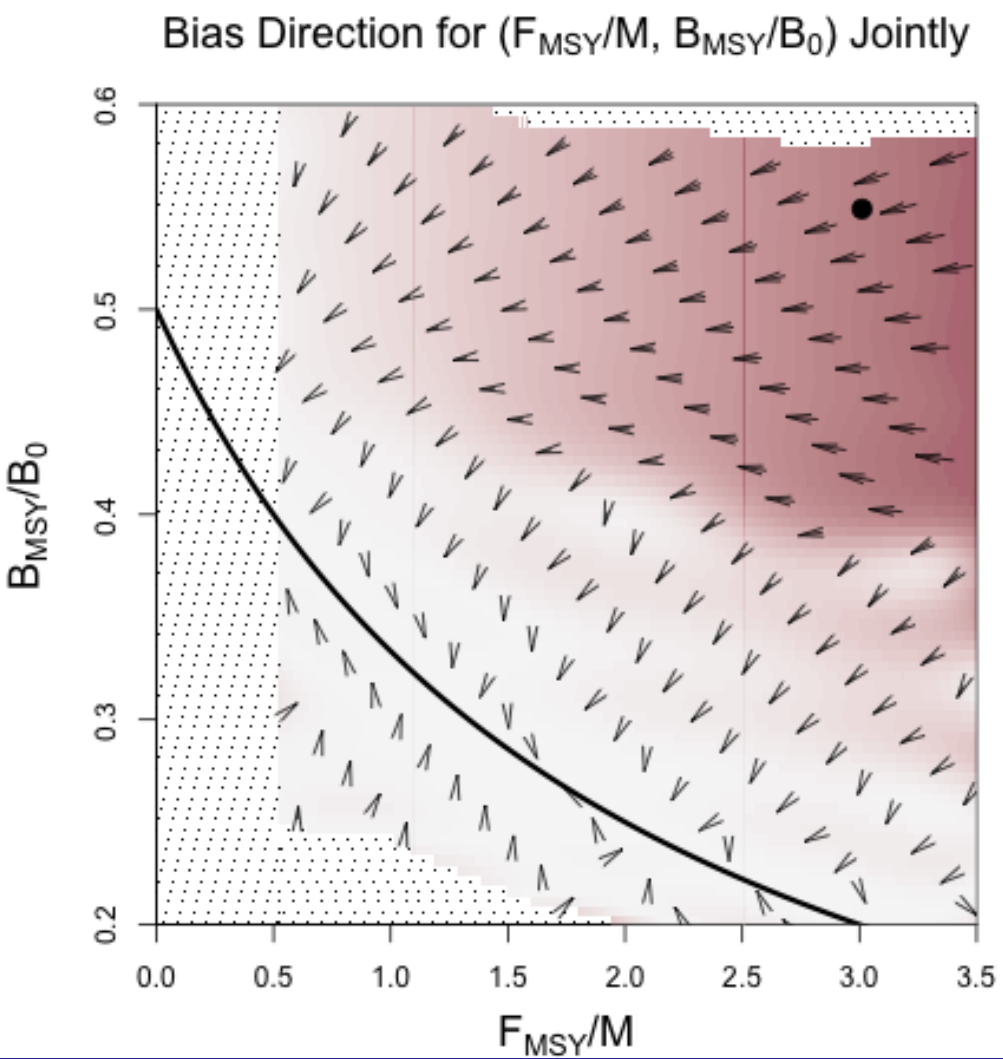

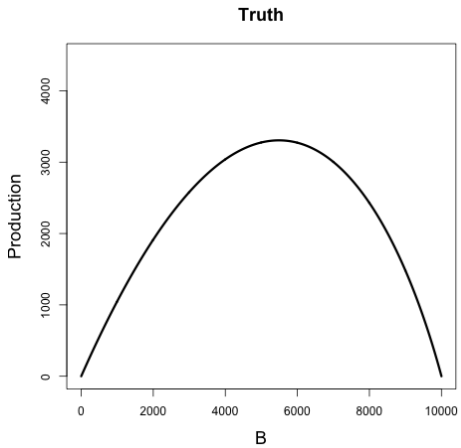

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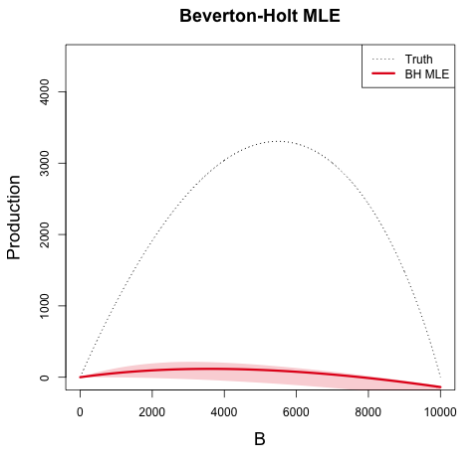

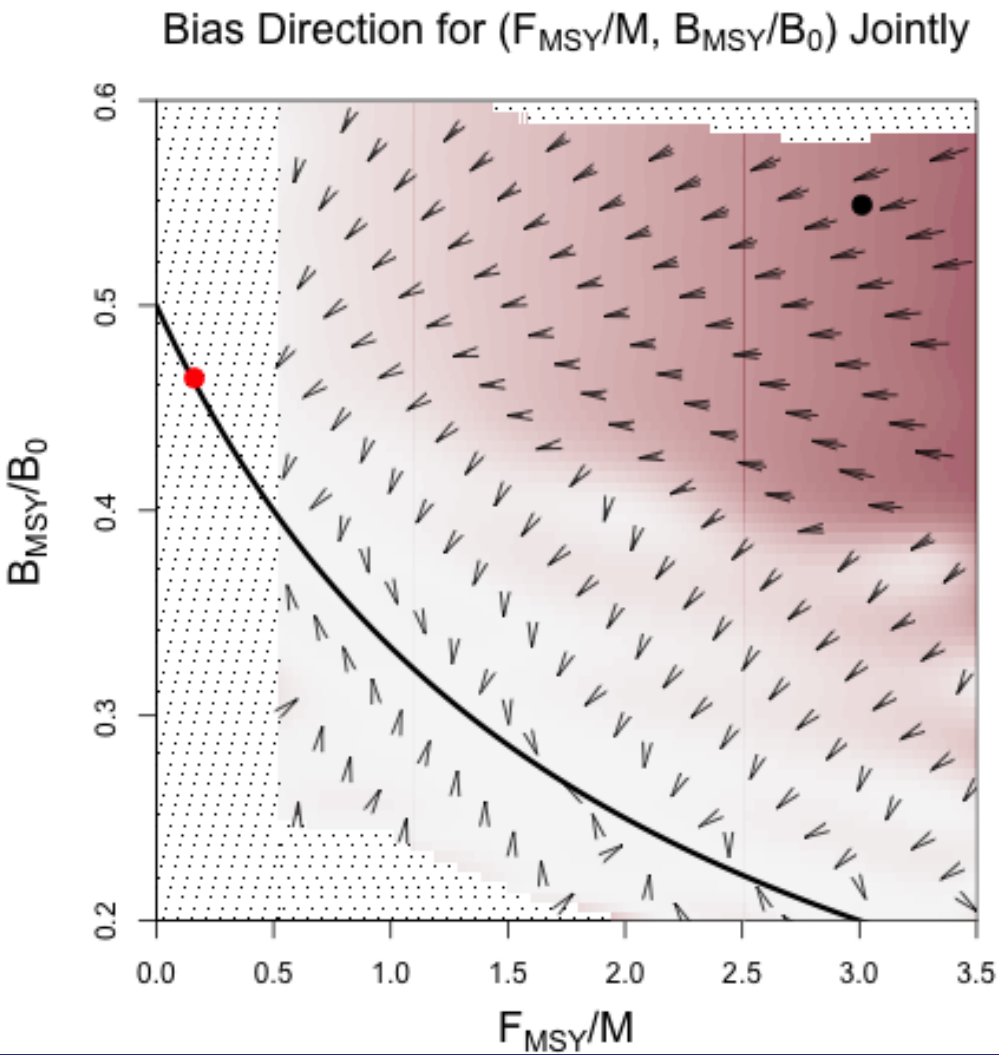

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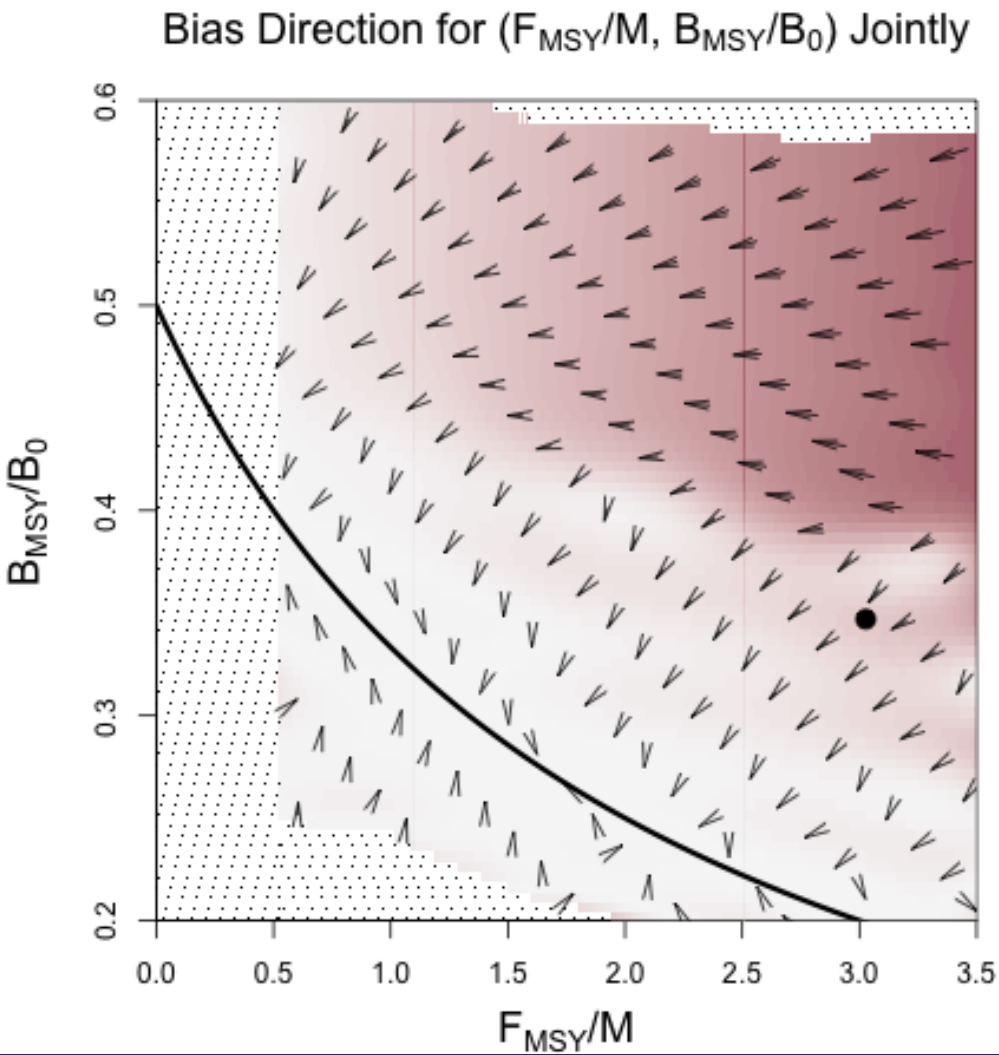

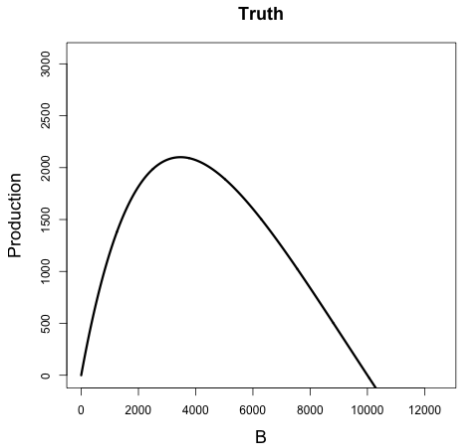

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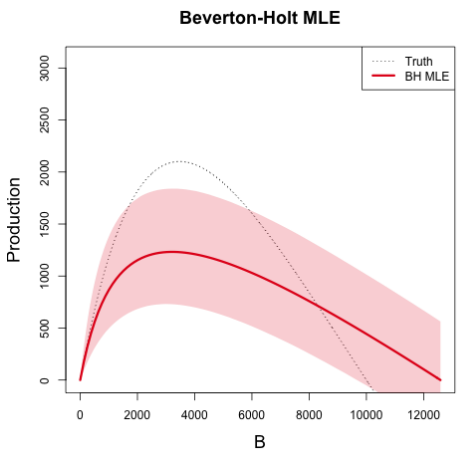

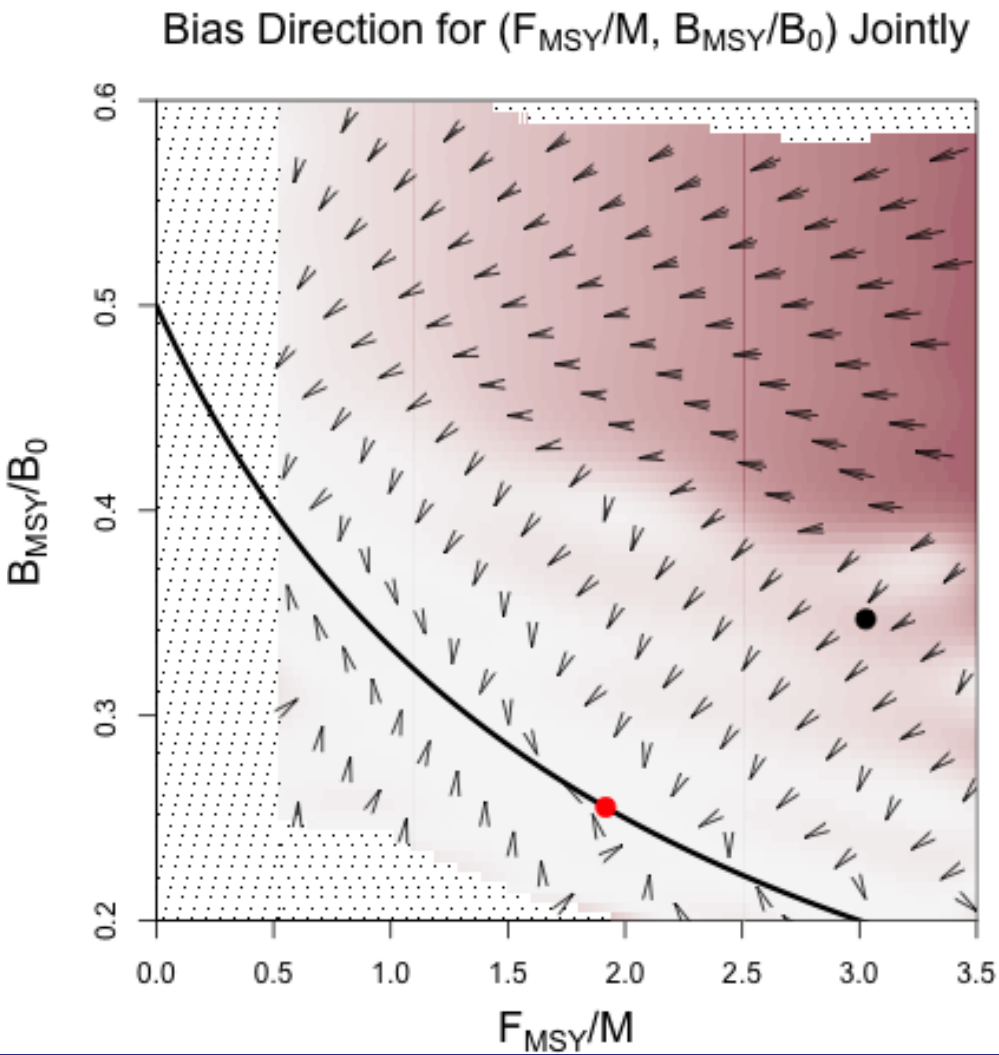

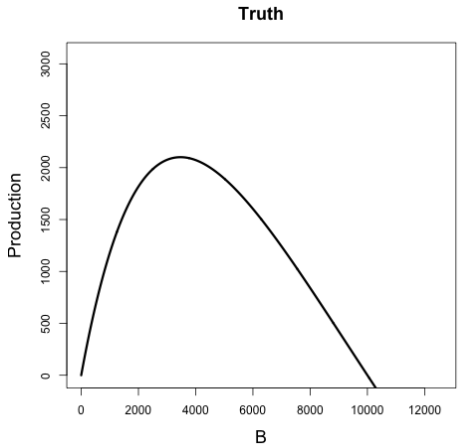

Conclusions

- Contrast story
- Importance of getting the computaional details correct for moving to analysis of Delay Difference and age structure