Prior for WCNPO Striped Marlin Bayesian Growth Curve Analysis

- Normal Distribution Prior for Mean Length (cm, EFL) at Age 15:
  - Mean Length = 212.0;
  - Standard Deviation =24.0;

Summary of length at age data from Sun et al. (2011)

From Chang (pers. comm., Nov 2022)

Age	Mean Length (cm, EFL)	Stdev (cm, EFL)	Sample Size (n)	CV of Length
0.5	108.15	8.69	276	8.0%
1	126.84	10.38	370	8.2%
2	146.68	10.32	350	7.0%
3	160.65	9.84	210	6.1%
4	172.91	9.45	71	5.5%
5	188.06	7.53	23	4.0%
6	193.34	8.03	7	4.2%
15	No Data	No Data	No Data	No Data

Note: CV of length is a decreasing function of mean length for observed data

Summary of MLS Mean Length Data from Kopf et al. (2011, Table 1)

	Mean Length (mm, LJFL)	Stdev (cm, EFL)	Sample Size (n)	CV of Length	Proportion of Total
Female Total	2300	281	206	12%	56.2 %
Male Total	2170	219	211	10%	43.8 %
Total	2243	254	417	11%	100 %

Note: CV of length reported for all striped marlin length-at-age samples

Improved Prior 2 for WCNPO Striped Marlin Bayesian Growth Curve Analysis

- Improved 2nd Normal Distribution Prior for Mean Length (cm, EFL) at Age 15:
  - Mean Length at Age-15 = 220.5;
  - Standard Deviation of Mean Length at Age-15 = 25.0;
  - CV of Mean Length at Age-15 = 0.1132;
- Note: Above CV set based on Kopf etal (2011) value in Prior 1
- This prior for mean length at age is derived from the 2019 Stock assessment of SW Pacic striped marlin in the WCPO (WCPFC-SC15-2019/SA-WP-07, page 17), the mean length for the last age in the SWP MLS model at age 10+ is reported as 220.53 cm, EFL with an associated growth coefficient value of k=0.4494;

Improved Prior 3 for WCNPO Striped Marlin Bayesian Growth Curve Analysis

- Improved 2nd Normal Distribution Prior for Mean Length (cm, EFL) at Age 15:
  - Mean Length at Age-15 = 220.5;
  - Standard Deviation of Mean Length at Age-15 = 2.2;
  - CV of Mean Length at Age-15 = 0.01;
- Prior 3 sets a tight constraint on the predicted mean length at age-15 by setting the CV of the normal prior to be 1%;
- This is *ad hoc* but represents the hypothesis that the information from the MLS growth curve used in the Southwest Pacific Ocean stock assessment is more accurate than the lack of information available in the observed mean length dat set from Sun et al (2011) which contains fish of reported ages 0.5 to 6 years of apparent age.

Growth models

SS-Richards

$$L_t = L_1 + (L_2 - L_1)\frac{1-\exp(-k*(a-0.5))}{1-\exp(-k*(15-0.5))} + \varepsilon$$

$$\varepsilon \sim N(0, \sigma^2)$$

SS-VB

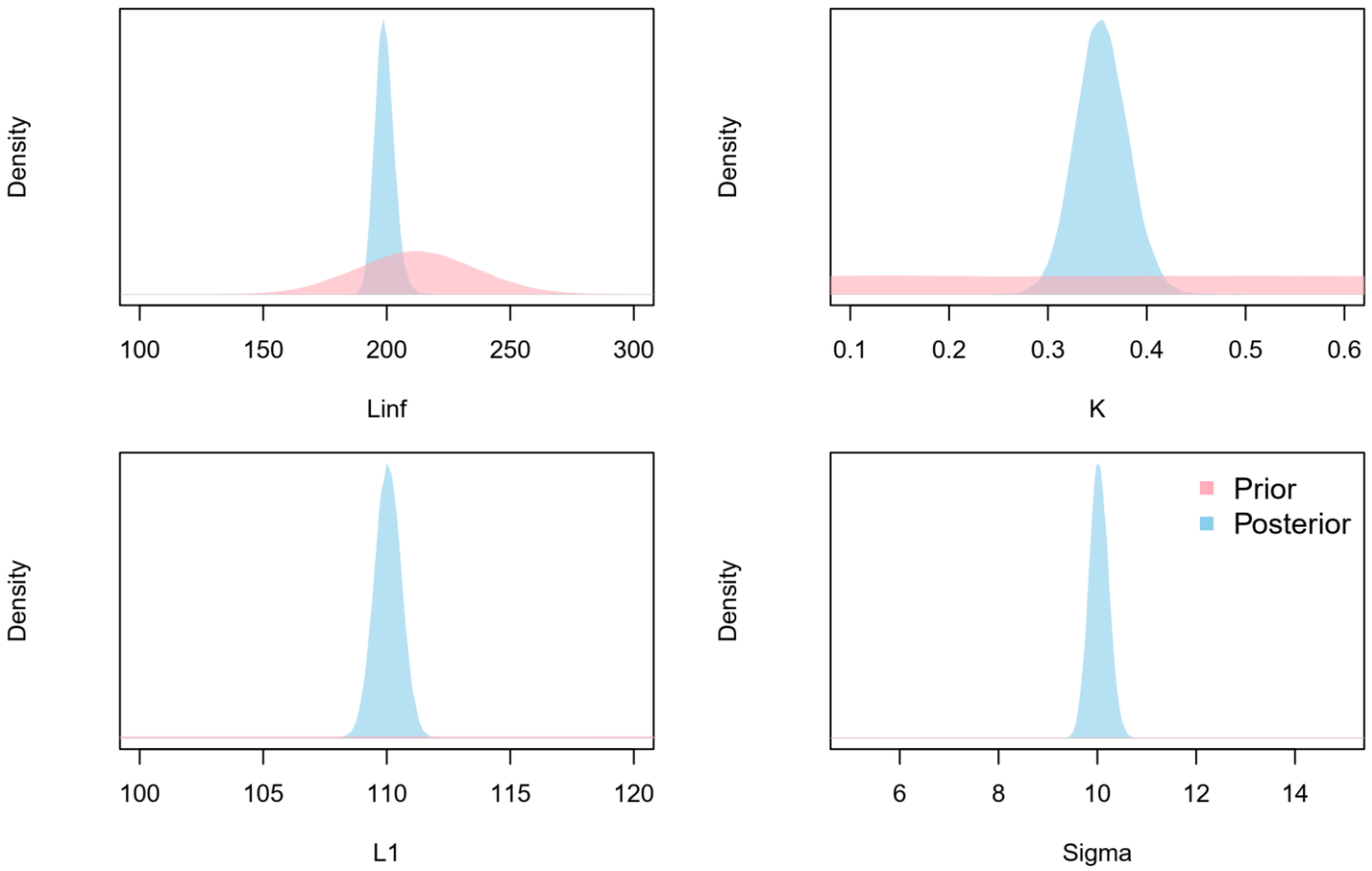
$$L_t = L_\infty + (L_1 - L_\infty) * \exp(-k*(a-0.5)) + \varepsilon$$

$$\varepsilon \sim N(0, \sigma^2)$$

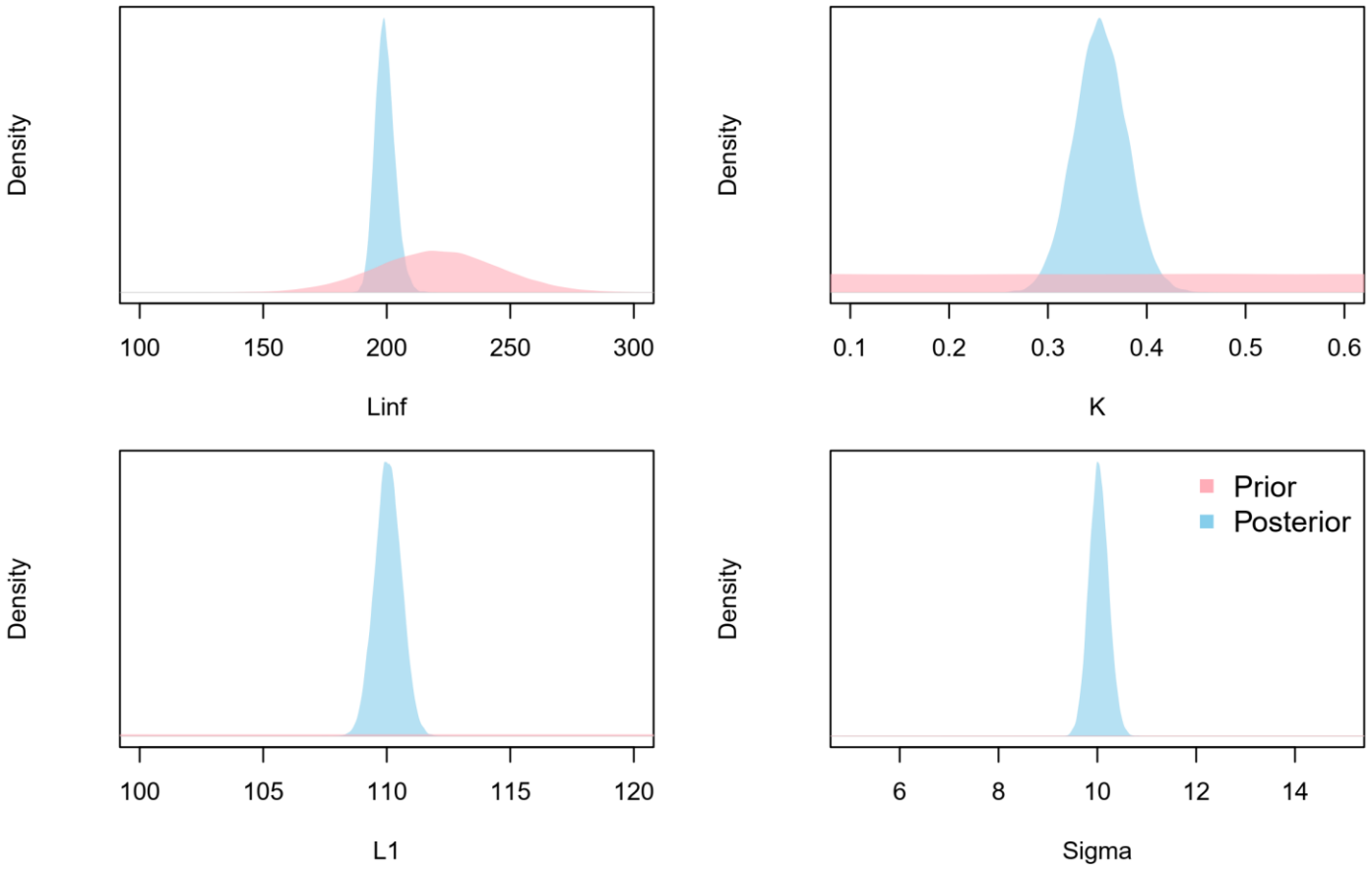
Priors

	Model	L2	Linf	K	L1	Sigma
Model 01	Richards	$N(212,24^2)$		U((0.001,1)	(0.001,200)	(0.001,200)
Model 02	Richards	$N(220.5,25^2)$				
Model 03	Richards	$N(220.5,2.2^2)$				
Model 04	VB		$N(212,24^2)$			
Model 05	VB		$N(220.5,25^2)$			
Model 06	VB		$N(220.5,2.2^2)$			

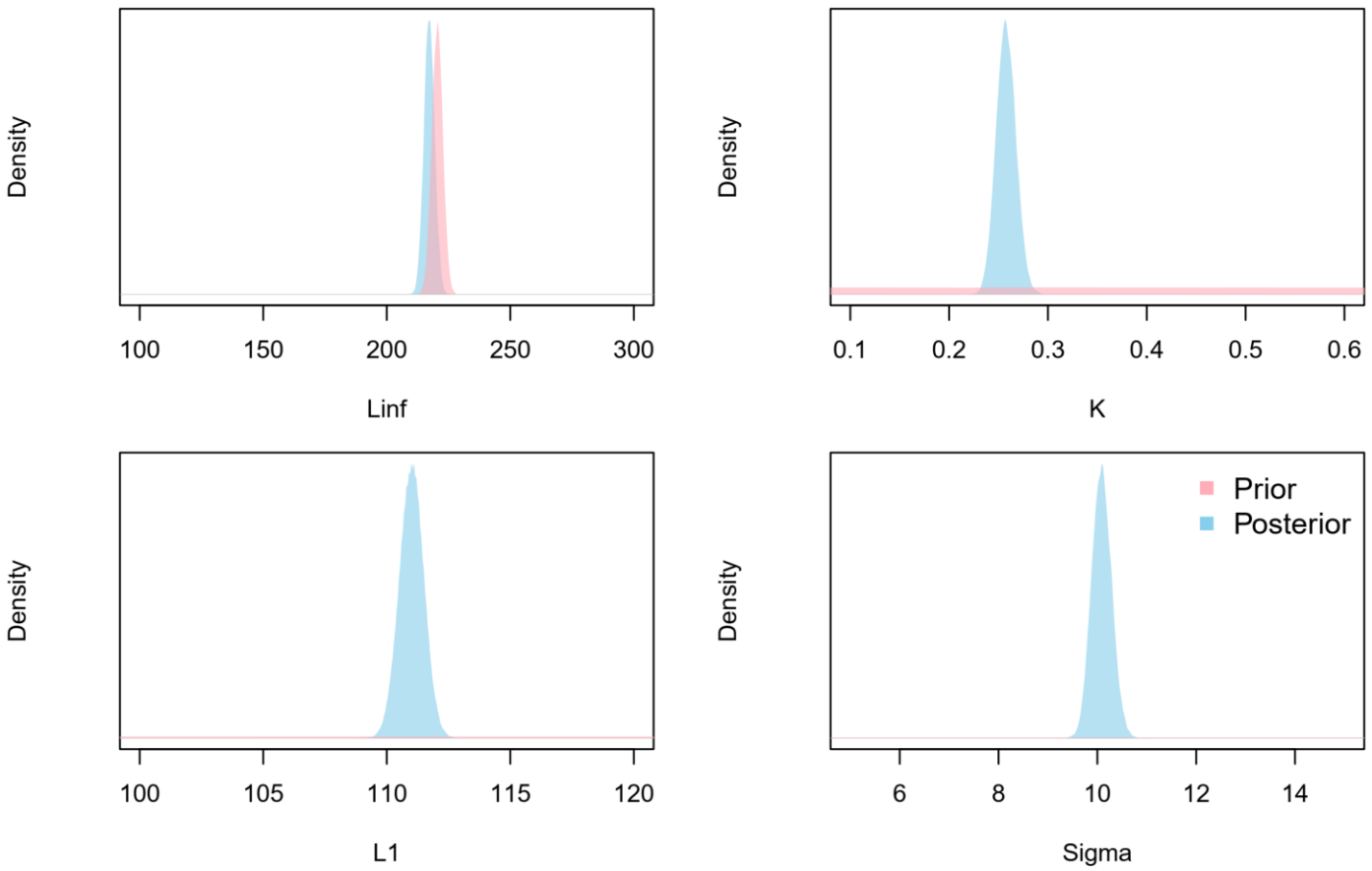
Model 01 (SS-Richards prior1)



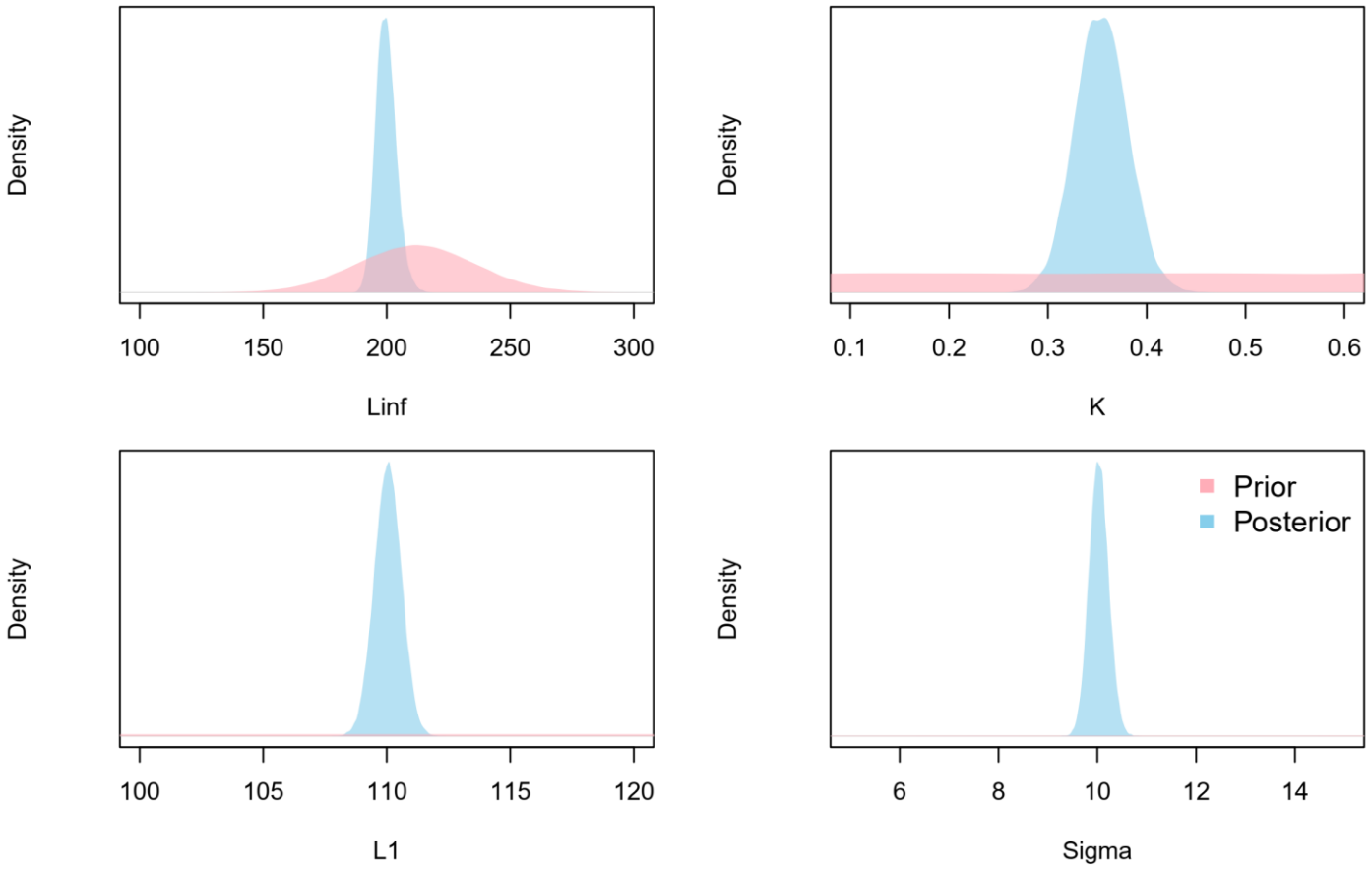
Model 02 (SS-Richards prior2)



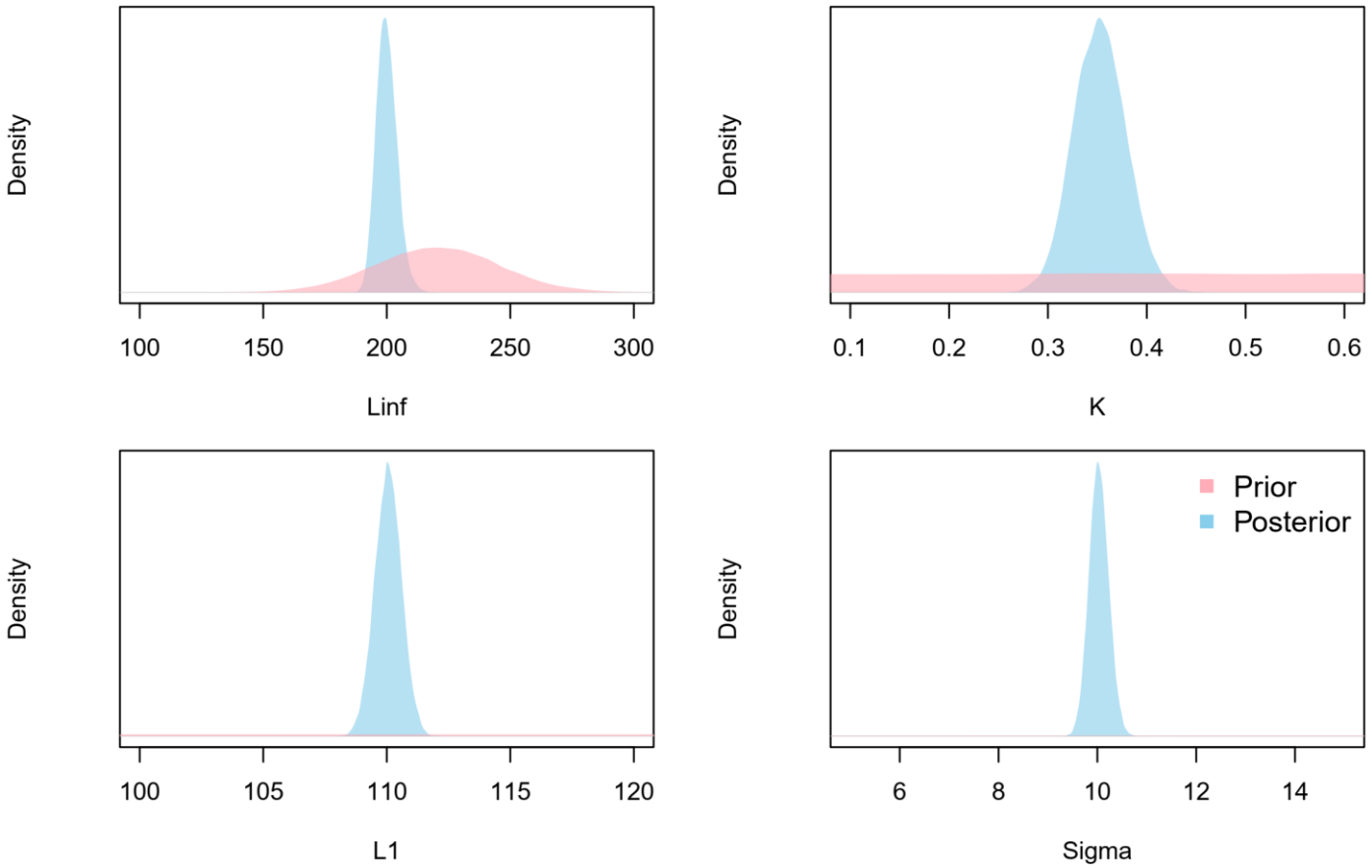
Model 03 (SS-Richards prior3)



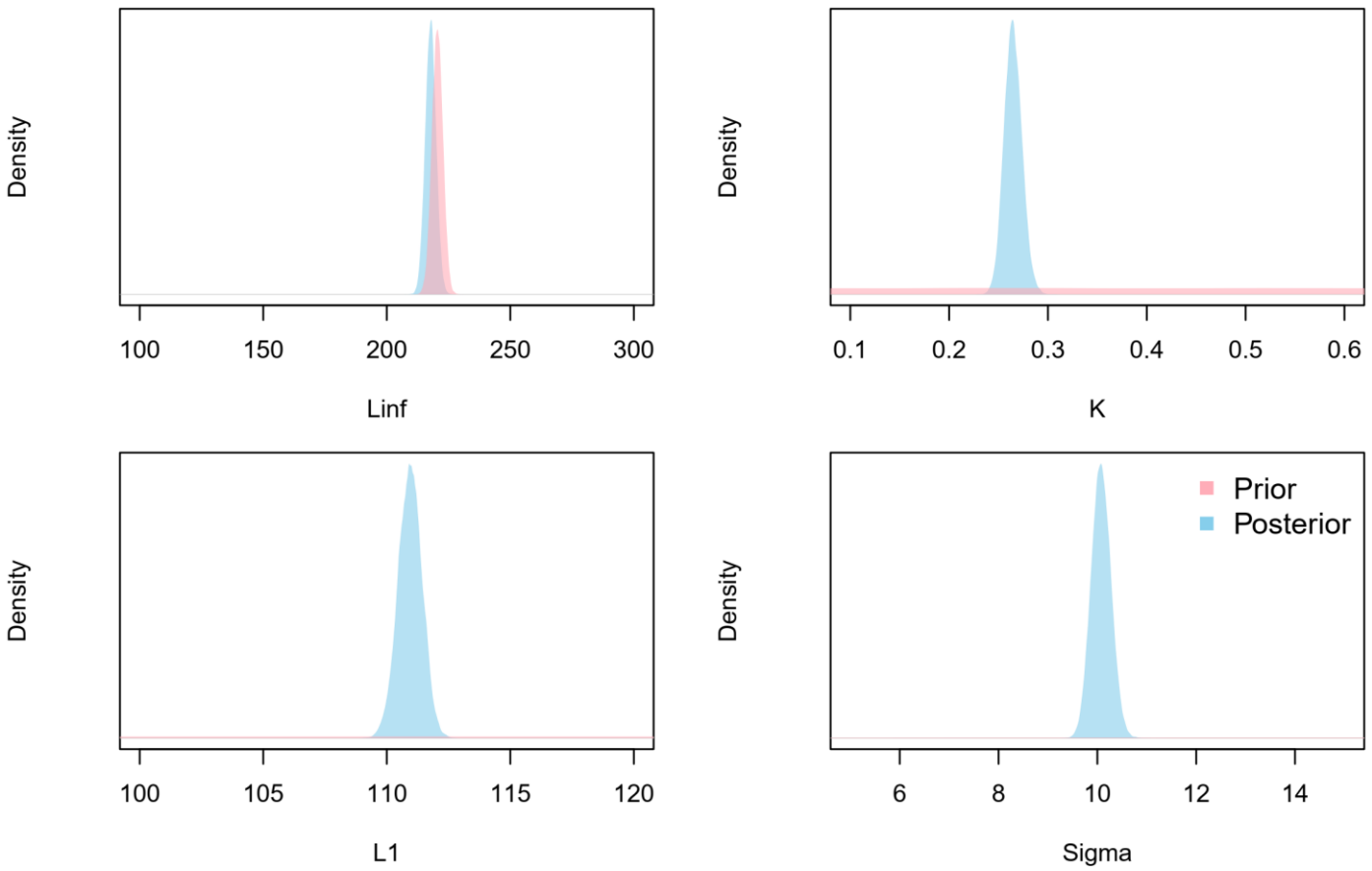
Model 04 (SS-VB prior1)



Model 05 (SS-VB prior2)



Model 06 (SS-VB prior3)



Posterior estimations

Richards_prior1						Richards_prior2				
node	mean	sd	2.50%	median	97.50%	mean	sd	2.50%	median	97.50%
K	0.3543	0.02652	0.3033	0.354	0.4073	0.3533	0.02664	0.3013	0.353	0.4059
L1	110	0.5403	109	110	111.1	110.1	0.539	109	110.1	111.1
L2	199.2	3.838	192.2	199	207.3	199.3	3.883	192.3	199.1	207.5
age0	92.7	1.195	90.31	92.72	95	92.74	1.197	90.36	92.76	95.04
age0.5	110	0.5403	109	110	111.1	110.1	0.539	109	110.1	111.1
age1	124.6	0.3444	123.9	124.6	125.2	124.6	0.3426	123.9	124.6	125.2
age2	146.9	0.4267	146.1	146.9	147.7	146.9	0.4277	146	146.9	147.7
age3	162.6	0.4274	161.7	162.6	163.4	162.6	0.429	161.7	162.6	163.4
age4	173.6	0.719	172.2	173.6	175	173.6	0.723	172.2	173.6	175
age5	181.3	1.199	179	181.3	183.7	181.3	1.207	179	181.3	183.8
age6	186.7	1.698	183.5	186.7	190.1	186.8	1.711	183.5	186.8	190.2
age7	190.6	2.154	186.5	190.5	194.9	190.7	2.172	186.5	190.6	195.1
age8	193.3	2.548	188.5	193.2	198.5	193.4	2.571	188.5	193.3	198.6
age9	195.2	2.876	189.8	195.1	201.1	195.3	2.904	189.9	195.2	201.3
age10	196.5	3.143	190.7	196.4	203	196.6	3.175	190.8	196.5	203.2
age11	197.5	3.357	191.3	197.3	204.5	197.6	3.393	191.4	197.4	204.6
age12	198.1	3.526	191.7	198	205.5	198.3	3.564	191.8	198.1	205.7
age13	198.6	3.657	191.9	198.4	206.3	198.7	3.698	192.1	198.5	206.5
age14	198.9	3.759	192.1	198.7	206.9	199.1	3.803	192.2	198.9	207.1
age15	199.2	3.838	192.2	199	207.3	199.3	3.883	192.3	199.1	207.5
deviance	9735	2.808	9731	9734	9742	9735	2.843	9731	9734	9742
obs_sigma	10.03	0.1963	9.653	10.03	10.42	10.03	0.1963	9.652	10.03	10.42

Posterior estimations

Richards_prior3

node	mean	sd	2.50%	median	97.50%
K	0.2578	0.00988	0.2389	0.2575	0.2776
L1	111	0.4903	110	111	112
L2	217.2	2.131	213.1	217.2	221.4
age0	96.04	0.8026	94.45	96.06	97.6
age0.5	111	0.4903	110	111	112
age1	124.2	0.3287	123.5	124.2	124.8
age2	145.9	0.3484	145.2	145.9	146.6
age3	162.7	0.4368	161.8	162.7	163.5
age4	175.6	0.5185	174.6	175.6	176.6
age5	185.7	0.6371	184.4	185.7	186.9
age6	193.4	0.7999	191.8	193.4	195
age7	199.4	0.988	197.5	199.4	201.3
age8	204	1.182	201.7	204	206.3
age9	207.6	1.368	204.9	207.6	210.3
age10	210.4	1.54	207.3	210.4	213.4
age11	212.5	1.694	209.2	212.5	215.8
age12	214.2	1.83	210.6	214.2	217.8
age13	215.5	1.947	211.7	215.4	219.3
age14	216.4	2.046	212.5	216.4	220.5
age15	217.2	2.131	213.1	217.2	221.4
deviance	9749	3.731	9743	9749	9757
obs_sigma	10.09	0.1994	9.708	10.09	10.49

Posterior estimations

VB_prior1						VB_prior2				
Node	mean	sd	2.50%	median	97.50%	mean	sd	2.50%	median	97.50%
K	0.3543	0.02658	0.3035	0.354	0.407	0.3527	0.02662	0.3019	0.3524	0.4061
L1	110	0.545	109	110	111.1	110.1	0.538	109	110.1	111.1
Linf	199.7	4.073	192.4	199.5	208.3	200	4.133	192.6	199.8	208.7
age0	92.71	1.206	90.3	92.73	95.02	92.76	1.194	90.37	92.78	95.03
age0.5	110	0.545	109	110	111.1	110.1	0.538	109	110.1	111.1
age1	124.6	0.3445	123.9	124.6	125.2	124.5	0.3425	123.9	124.5	125.2
age2	146.9	0.4301	146	146.9	147.7	146.9	0.426	146	146.9	147.7
age3	162.6	0.4318	161.7	162.6	163.4	162.6	0.4269	161.7	162.6	163.4
age4	173.6	0.7189	172.2	173.6	175	173.6	0.7228	172.2	173.6	175
age5	181.3	1.196	179	181.3	183.7	181.4	1.208	179	181.4	183.8
age6	186.7	1.693	183.5	186.7	190.1	186.9	1.712	183.5	186.8	190.2
age7	190.6	2.149	186.5	190.5	194.9	190.7	2.173	186.6	190.7	195
age8	193.3	2.542	188.5	193.2	198.4	193.4	2.572	188.6	193.4	198.6
age9	195.2	2.87	189.8	195.1	201	195.4	2.905	189.9	195.3	201.2
age10	196.5	3.137	190.7	196.4	203	196.7	3.176	190.8	196.6	203.2
age11	197.5	3.35	191.3	197.3	204.4	197.7	3.393	191.4	197.5	204.6
age12	198.1	3.518	191.6	198	205.4	198.3	3.564	191.8	198.2	205.7
age13	198.6	3.65	191.9	198.4	206.2	198.8	3.698	192.1	198.7	206.5
age14	198.9	3.751	192.1	198.8	206.7	199.2	3.802	192.3	199	207.1
age15	199.2	3.83	192.2	199	207.2	199.4	3.882	192.4	199.2	207.5
deviance	9735	2.811	9731	9734	9742	9735	2.816	9731	9734	9742
obs_sigma	10.03	0.1946	9.658	10.03	10.42	10.03	0.1974	9.654	10.03	10.43

Posterior estimations

VB_prior3

node	mean	sd	MC error	median	97.50%
K	0.2648	0.009	5.28E-05	0.2645	0.2831
L1	110.9	0.4826	0.00275	110.9	111.9
Linf	217.8	2.162	0.0123	217.8	222
age0	95.83	0.7804	0.00449	95.84	97.33
age0.5	110.9	0.4826	0.00275	110.9	111.9
age1	124.2	0.326	0.00187	124.2	124.8
age2	145.9	0.3414	0.00204	145.9	146.6
age3	162.6	0.4324	0.00253	162.6	163.5
age4	175.4	0.5128	0.00292	175.4	176.5
age5	185.3	0.6163	0.00344	185.3	186.5
age6	192.8	0.7525	0.00417	192.8	194.3
age7	198.6	0.9089	0.00504	198.6	200.4
age8	203.1	1.07	0.00596	203.1	205.1
age9	206.5	1.225	0.00685	206.5	208.9
age10	209.1	1.368	0.00768	209.1	211.7
age11	211.1	1.495	0.00842	211.1	214
age12	212.7	1.607	0.00906	212.7	215.8
age13	213.8	1.702	0.00962	213.9	217.1
age14	214.8	1.784	0.01009	214.8	218.2
age15	215.5	1.852	0.01049	215.5	219
deviance	9747	3.386	0.01897	9747	9754
obs_sigma	10.08	0.1982	0.00111	10.07	10.47

Plot of growth curves