

Figure 1: Estimated fit for the Ball-Stick model for the voxel at position (52, 62, 25). As the parameters were not bound to realistic ranges the resultant fit is really bad.

Q1.1.2

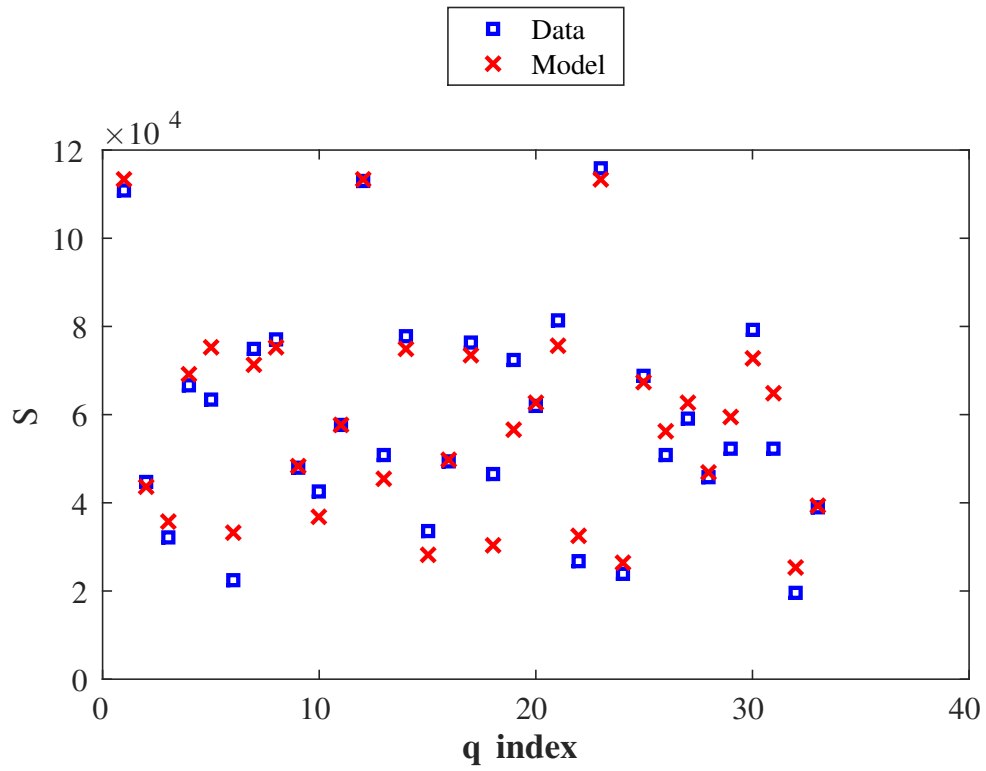


Figure 2: Estimated fit for the Ball-Stick model for the voxel at position (52, 62, 25). After constraining the parameters to reasonable ranges, the fit is much better.

Q1.1.4



Figure 3: The first thing to notice is that both maps contain some artefacts around the brain due to the skull. (a) The S_0 values are high in gray matter and CSF and low in white matter. (b) The D values are high in CSF and gray matter and contain many artefacts around the brain, and even some (high) outliers inside the brain.



Figure 4: (a) Artefacts around the brain are clearly visible. The F map is the best at distinguishing between gray-matter/CSF and white matter. White matter which is made of axons has high f values, while gray matter which is made of the bodies of the neurons has lower values of f . (b) The $RESNORM$ map has some interesting intensity peaks in gray-matter areas at the periphery of the brain, suggesting that the fit using the BallStick model has not been good in those voxels. Better models should therefore look at ways to model these areas, by changing S_I suitably.

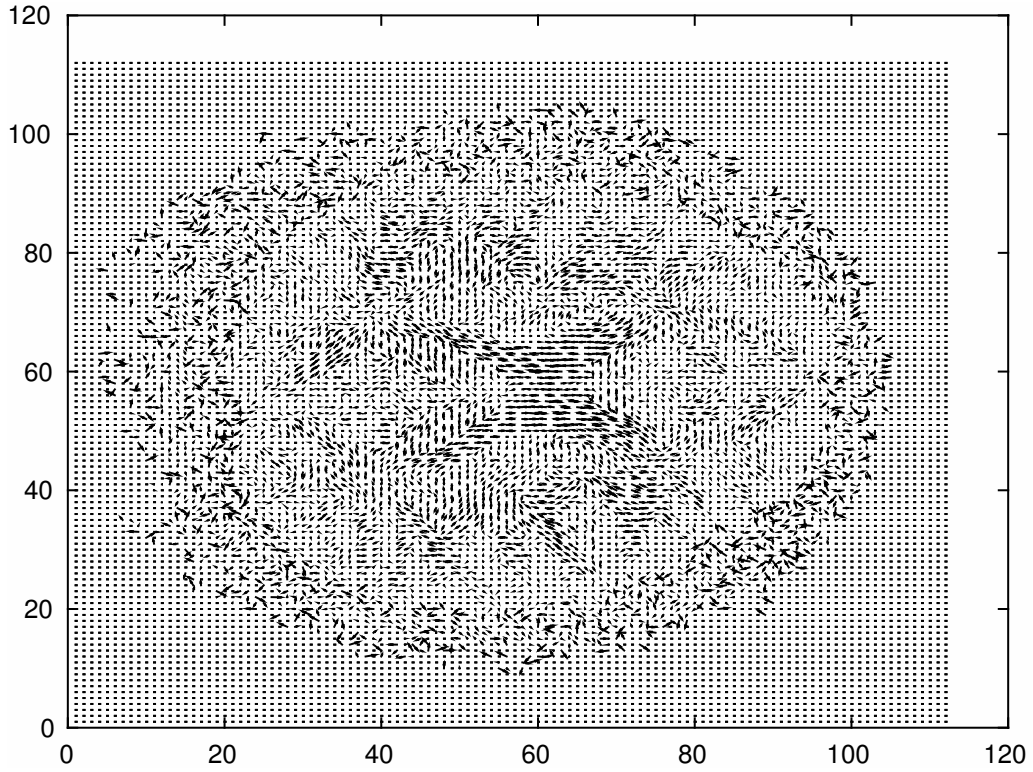


Figure 5: Fibre direction map clearly shows strong horizontal directions in the ventricles, suggesting a lot of axons that move from the front to the back of the brain. As the fibre direction map has been weighted by f , the gray matter areas don't show strong diffusion in a particular direction. The arrows around the brain have random orientations due to artifacts in the skull.

Q1.2.1

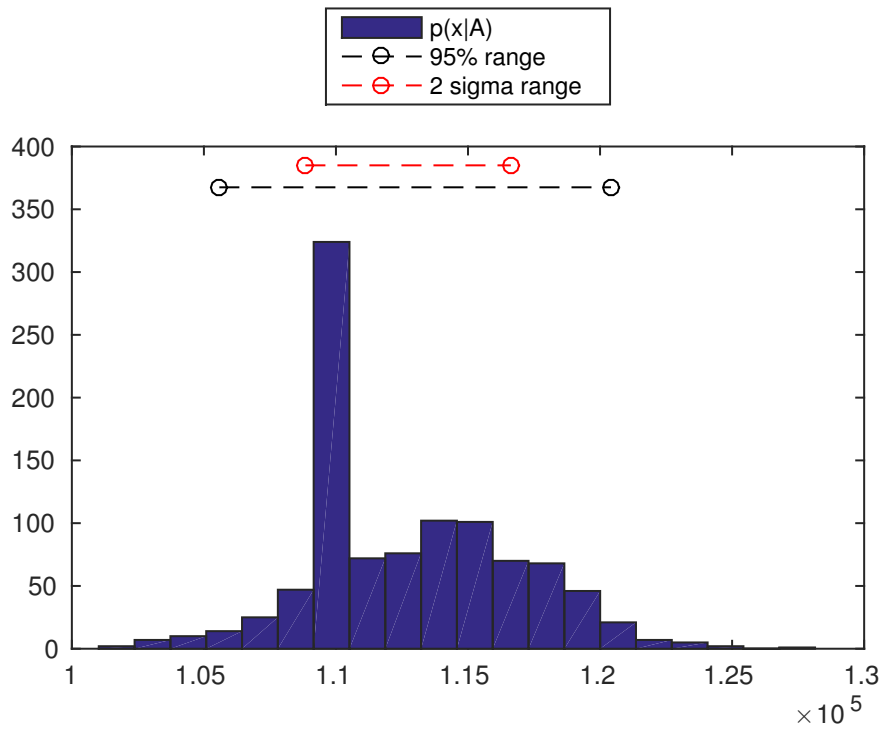


Figure 6: Parametric bootstrap for S_0 using voxel (52,62,25)

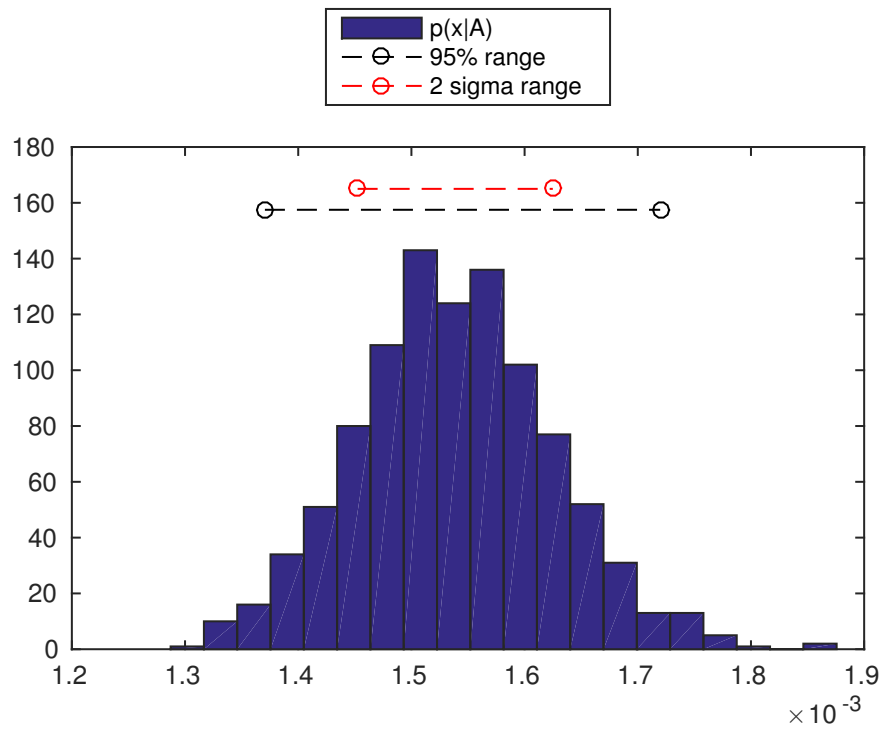


Figure 7: Parametric bootstrap for d using voxel (52,62,25)

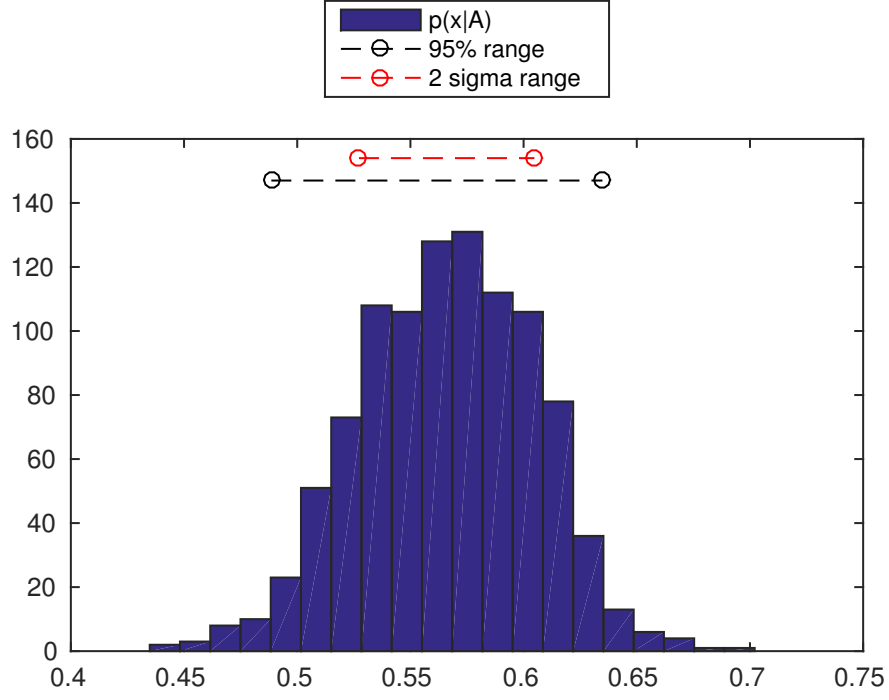


Figure 8: Parametric bootstrap for f using voxel (52,62,25)

2-sigma ranges						
Voxel	$S0$		d		f	
(52,62,25)	1.088e+05	1.166e+05	1.452e-03	1.624e-03	0.527	0.604
(63,40,18)	1.017e+05	1.229e+05	1.026e-03	1.397e-03	0.136	0.326
(70,64,14)	1.022e+05	1.112e+05	7.584e-04	8.928e-04	0.078	0.185

95% confidence intervals						
(52,62,25)	1.055e+05	1.204e+05	1.370e-03	1.719e-03	0.488	0.634
(63,40,18)	0.918e+05	1.330e+05	0.870e-03	1.608e-03	0.000	0.404
(70,64,14)	0.976e+05	1.152e+05	6.888e-04	9.507e-04	0.000	0.231

Table 1: 2-sigma and 95% confidence intervals for voxel (52,62,25) using Parametric bootstrap. All voxels have similar ranges for $S0$, however voxel (70,64,14) has different ranges for d and f , probably because it is a CSF or gray matter voxel.

Q1.2.2 & Q1.2.3

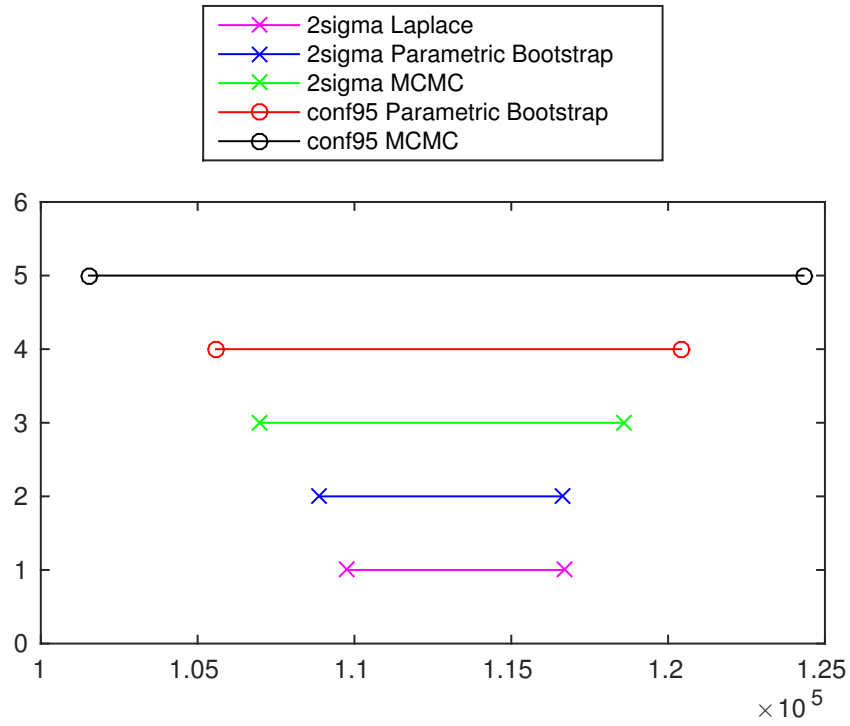


Figure 9: 2σ and 95% confidence intervals on parameter S_0 using three different methods: parametric bootstrap, MCMC and Laplace. Voxel used was (52,62,25)

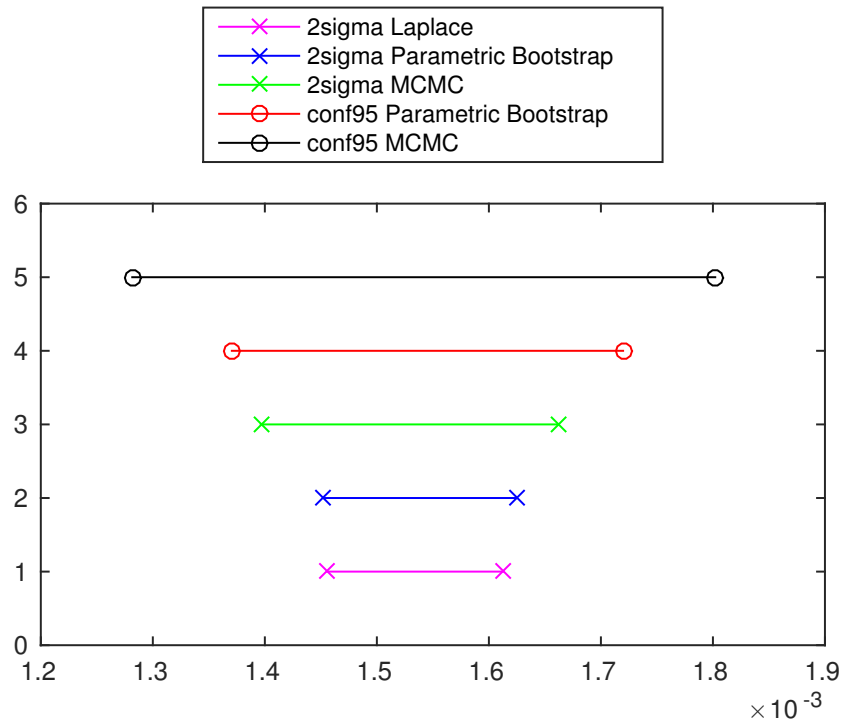


Figure 10: 2σ and 95% confidence intervals on parameter d using three different methods: parametric bootstrap, MCMC and Laplace. Voxel used was (52,62,25)

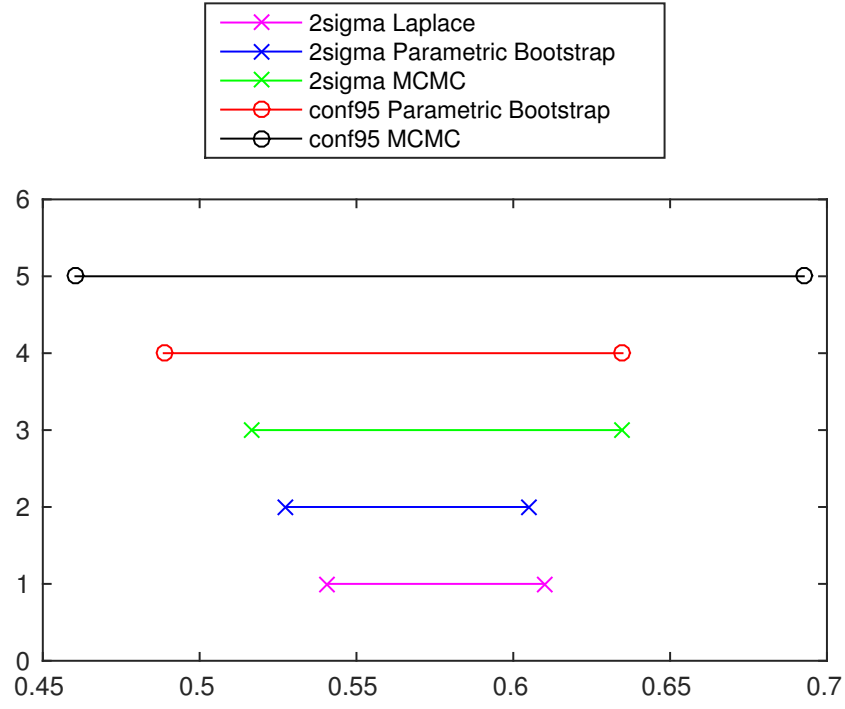


Figure 11: 2σ and 95% confidence intervals on parameter f using three different methods: parametric bootstrap, MCMC and Laplace. Voxel used was (52,62,25)

Q1.3.1

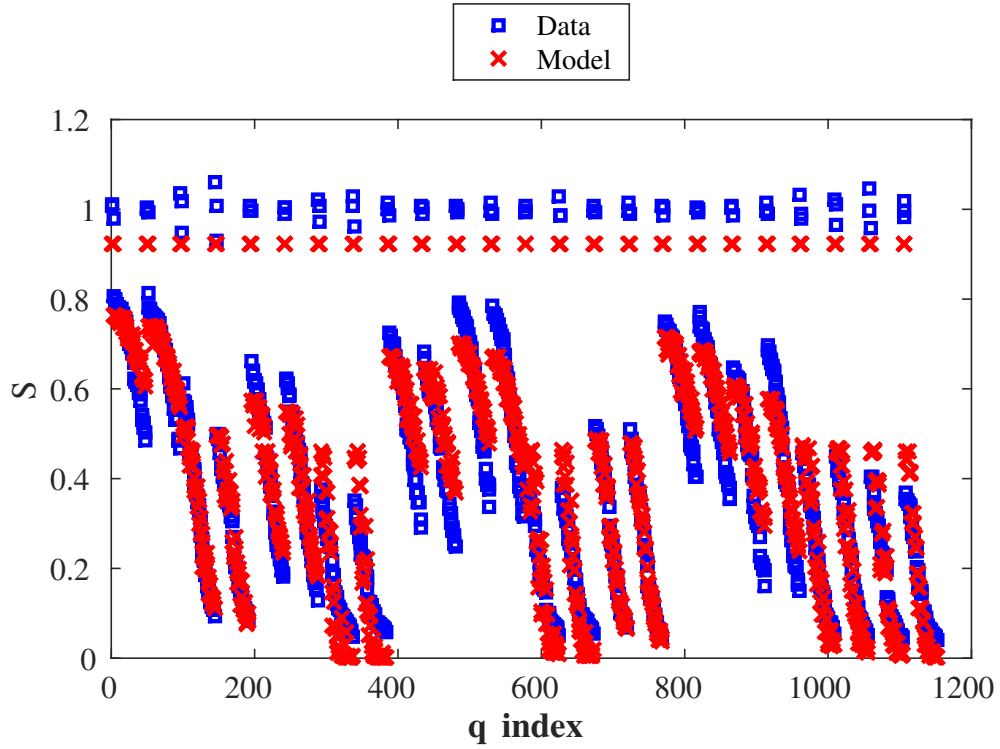


Figure 12: Estimated fit for the Ball-Stick model for the given voxel. RESNORM=3.8681. It should be noted the low value for S_0 that gives a poor fit to the voxels with b -value=0.

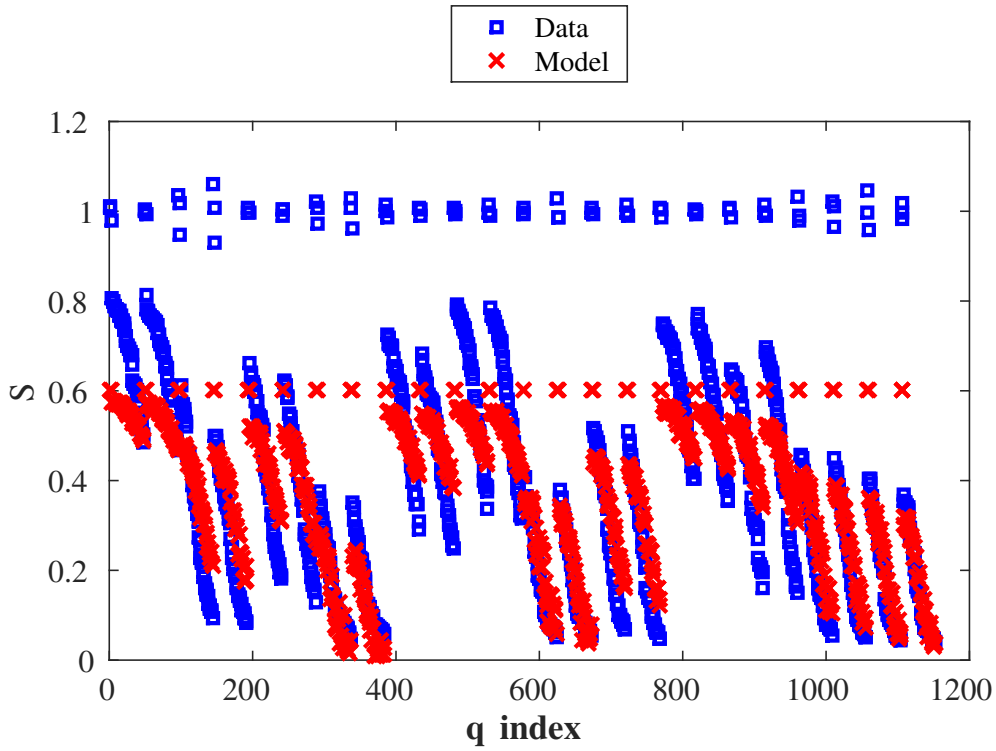


Figure 13: Estimated fit for Diffusion Tensor model for the given voxel. RESNORM=20.5832. It should be noted the low value for S_0 that gives a poor fit to the voxels with $b\text{-value}=0$. The DTI model performs the worst out of all the models we tried.

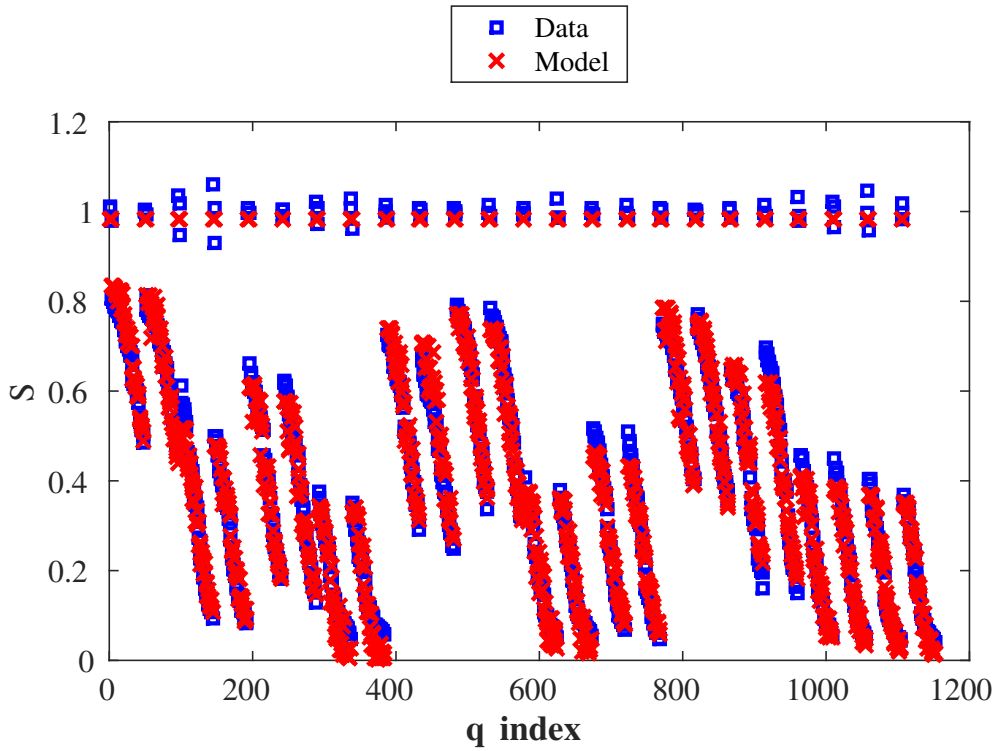


Figure 14: Estimated fit for Zeppelin-Stick model for the given voxel. RESNORM=1.1784. The Zeppelin-Stick had one of the best fits out of all the models we studied.

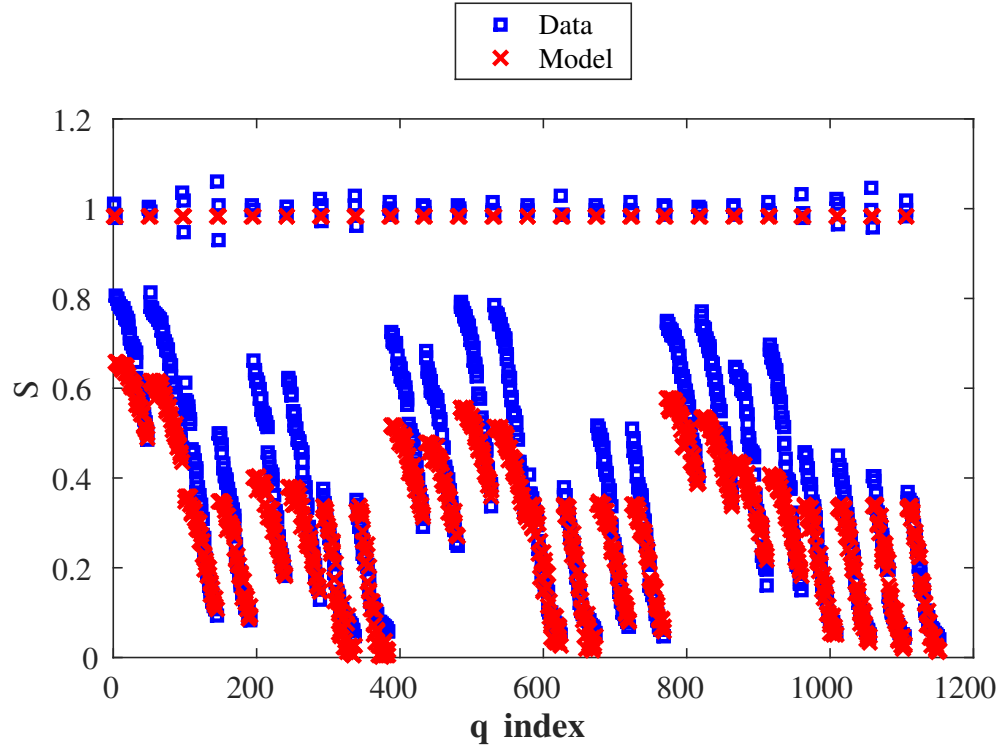


Figure 15: Estimated fit for Zeppelin-Stick with tortuosity model for the given voxel. RESNORM=2.1337. The value for S_0 is good but the constraint for λ_2 gives it a poor fit to the voxels where the 24x45 measurements where b-value is not zero.