Supplementary Material

A New Regression Model for the Analysis of Overdispersed and Zero-modified Count Data

Wesley Bertoli, Katiane S. Conceição,
Marinho G. Andrade and Francisco Louzada

Abstract

This supplementary material contains all the results obtained from the Monte Carlo simulation study described in Section 4 of the manuscript. In all Figures, the straight blue lines represent the actual values, and the 95% HPDIs are represented by the dashed red lines. The filled black dots represent the estimated values for each generated observation.

1 Zero-inflated artificial data

1.1 Using *logit* link function

Table 1: Empirical properties of the Bayesian estimators using zero-inflated artificial samples (Scenarios 1 and 2).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
Scenario 1					
50	β_{10}	−0.116	0.336	1.020	29.127
	β_{11}	−0.527	1.784	1.088	30.652
	β_{20}	0.119	0.329	1.022	45.714
	β_{21}	0.116	0.990	1.007	78.781
100	β_{10}	−0.097	0.161	1.031	20.605
	β_{11}	−0.138	0.480	1.020	18.120
	β_{20}	0.084	0.247	1.014	40.288
	β_{21}	0.053	0.774	1.002	70.962
200	β_{10}	−0.033	0.058	1.010	12.471
	β_{11}	−0.098	0.193	1.026	11.590
	β_{20}	0.012	0.110	1.001	26.005
	β_{21}	0.061	0.412	1.004	50.919
500	β_{10}	−0.032	0.022	1.024	7.870
	β_{11}	−0.011	0.064	1.001	6.794
	β_{20}	0.009	0.049	1.001	17.633
	β_{21}	0.023	0.169	1.002	33.136
Scenario 2					
50	β_{10}	−0.164	0.180	1.085	21.689
	β_{11}	−0.136	0.382	1.025	16.319
	β_{20}	0.128	0.328	1.026	45.883
	β_{21}	−0.081	0.896	1.004	151.990
100	β_{10}	−0.078	0.094	1.034	15.908
	β_{11}	−0.075	0.204	1.014	11.916
	β_{20}	0.049	0.217	1.006	36.781
	β_{21}	−0.016	0.574	1.000	117.390
200	β_{10}	−0.051	0.044	1.031	11.079
	β_{11}	−0.010	0.104	1.000	8.443
	β_{20}	0.010	0.101	1.000	25.223
	β_{21}	0.013	0.322	1.000	90.972
500	β_{10}	−0.024	0.015	1.019	6.533
	β_{11}	−0.005	0.033	1.000	4.778
	β_{20}	0.005	0.039	1.000	15.802
	β_{21}	0.002	0.104	1.000	52.292

Table 2: Empirical properties of the Bayesian estimators using zero-inflated artificial samples (Scenarios 3 and 4).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 3		
50	β_{10}	−0.338	0.584	1.115	37.493
	β_{11}	0.281	1.758	1.023	69.019
	β_{20}	0.109	0.388	1.016	49.700
	β_{21}	0.186	1.102	1.016	84.008
100	β_{10}	−0.120	0.241	1.032	24.811
	β_{11}	−0.036	1.045	1.001	52.507
	β_{20}	0.056	0.222	1.007	38.480
	β_{21}	0.104	0.681	1.008	67.186
200	β_{10}	−0.071	0.105	1.025	16.547
	β_{11}	−0.005	0.526	1.000	38.617
	β_{20}	0.006	0.106	1.000	25.932
	β_{21}	0.066	0.405	1.005	50.259
500	β_{10}	−0.024	0.039	1.008	10.202
	β_{11}	−0.002	0.171	1.000	21.413
	β_{20}	0.005	0.051	1.000	17.858
	β_{21}	0.043	0.166	1.006	32.488
			Scenario 4		
50	β_{10}	−0.221	0.386	1.070	31.170
	β_{11}	0.138	1.024	1.009	54.128
	β_{20}	0.086	0.380	1.010	48.477
	β_{21}	−0.063	1.108	1.002	165.519
100	β_{10}	−0.114	0.192	1.035	23.082
	β_{11}	0.062	0.584	1.003	41.147
	β_{20}	0.068	0.218	1.011	37.185
	β_{21}	−0.076	0.700	1.004	133.345
200	β_{10}	−0.052	0.067	1.021	13.693
	β_{11}	0.011	0.236	1.000	26.593
	β_{20}	0.040	0.080	1.010	22.414
	β_{21}	−0.033	0.269	1.002	81.162
500	β_{10}	−0.025	0.028	1.012	8.884
	β_{11}	0.022	0.093	1.002	16.306
	β_{20}	−0.001	0.042	1.000	16.202
	β_{21}	0.010	0.118	1.000	54.116

Table 3: *Posterior* estimates for model parameters using zero-inflated artificial samples (Scenarios 1 and 2).

n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
Scenario 1						
50	β_{10}	1.384	1.386	0.568	0.416	2.348
	β_{11}	2.473	2.461	1.228	0.736	4.230
	β_{20}	−0.881	−0.865	0.561	−2.184	0.395
	β_{21}	−0.884	−0.873	0.988	−3.221	1.432
100	β_{10}	1.403	1.403	0.390	0.701	2.105
	β_{11}	2.862	2.855	0.679	1.631	4.105
	β_{20}	−0.916	−0.907	0.490	−1.932	0.080
	β_{21}	−0.947	−0.942	0.878	−2.784	0.878
200	β_{10}	1.467	1.467	0.238	1.031	1.903
	β_{11}	2.902	2.897	0.428	2.089	3.721
	β_{20}	−0.988	−0.983	0.332	−1.635	−0.346
	β_{21}	−0.939	−0.933	0.639	−2.219	0.332
500	β_{10}	1.468	1.468	0.147	1.188	1.748
	β_{11}	2.989	2.987	0.253	2.505	3.476
	β_{20}	−0.991	−0.988	0.220	−1.414	−0.571
	β_{21}	−0.977	−0.975	0.410	−1.758	−0.200
Scenario 2						
50	β_{10}	1.336	1.336	0.391	0.588	2.087
	β_{11}	2.864	2.858	0.603	1.725	4.011
	β_{20}	−0.872	−0.860	0.558	−2.071	0.308
	β_{21}	0.419	0.416	0.943	−1.571	2.415
100	β_{10}	1.422	1.422	0.296	0.849	1.997
	β_{11}	2.925	2.922	0.445	2.023	3.828
	β_{20}	−0.951	−0.943	0.464	−1.880	−0.032
	β_{21}	0.484	0.479	0.758	−1.071	2.052
200	β_{10}	1.449	1.449	0.204	1.082	1.814
	β_{11}	2.990	2.989	0.322	2.395	3.590
	β_{20}	−0.990	−0.986	0.318	−1.582	−0.404
	β_{21}	0.513	0.513	0.567	−0.546	1.569
500	β_{10}	1.476	1.476	0.121	1.239	1.714
	β_{11}	2.995	2.994	0.181	2.631	3.359
	β_{20}	−0.995	−0.993	0.198	−1.380	−0.611
	β_{21}	0.502	0.502	0.322	−0.139	1.147

Table 4: *Posterior* estimates for model parameters using zero-inflated artificial samples (Scenarios 3 and 4).

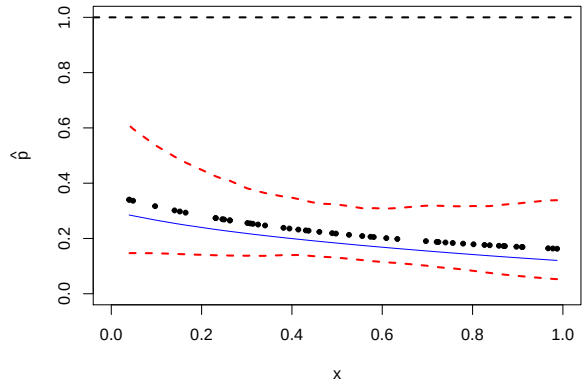
n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
Scenario 3						
50	β_{10}	1.162	1.175	0.685	−0.184	2.482
	β_{11}	−1.219	−1.208	1.296	−3.982	1.521
	β_{20}	−0.891	−0.875	0.613	−2.200	0.382
	β_{21}	−0.814	−0.802	1.033	−3.143	1.484
100	β_{10}	1.380	1.386	0.476	0.414	2.335
	β_{11}	−1.536	−1.529	1.021	−3.569	0.479
	β_{20}	−0.944	−0.933	0.468	−1.960	0.057
	β_{21}	−0.896	−0.891	0.819	−2.729	0.928
200	β_{10}	1.429	1.432	0.317	0.846	2.009
	β_{11}	−1.505	−1.499	0.725	−2.882	−0.138
	β_{20}	−0.994	−0.989	0.325	−1.644	−0.353
	β_{21}	−0.934	−0.929	0.633	−2.218	0.335
500	β_{10}	1.476	1.477	0.196	1.108	1.843
	β_{11}	−1.502	−1.500	0.413	−2.317	−0.690
	β_{20}	−0.995	−0.993	0.225	−1.418	−0.575
	β_{21}	−0.957	−0.956	0.406	−1.736	−0.182
Scenario 4						
50	β_{10}	1.279	1.287	0.581	0.141	2.402
	β_{11}	−1.363	−1.356	1.003	−3.430	0.697
	β_{20}	−0.914	−0.901	0.610	−2.122	0.275
	β_{21}	0.437	0.434	1.051	−1.570	2.445
100	β_{10}	1.386	1.391	0.424	0.567	2.198
	β_{11}	−1.438	−1.437	0.762	−2.947	0.066
	β_{20}	−0.932	−0.925	0.462	−1.860	−0.016
	β_{21}	0.424	0.421	0.834	−1.137	1.991
200	β_{10}	1.448	1.450	0.253	0.945	1.949
	β_{11}	−1.489	−1.487	0.486	−2.502	−0.477
	β_{20}	−0.960	−0.957	0.280	−1.549	−0.376
	β_{21}	0.467	0.466	0.518	−0.587	1.522
500	β_{10}	1.475	1.476	0.166	1.150	1.799
	β_{11}	−1.478	−1.478	0.304	−2.083	−0.873
	β_{20}	−1.001	−1.000	0.204	−1.388	−0.616
	β_{21}	0.510	0.509	0.343	−0.133	1.155

Table 5: Coverage probabilities (%) of the HPDIs using zero-inflated artificial samples (Scenarios 1 and 2).

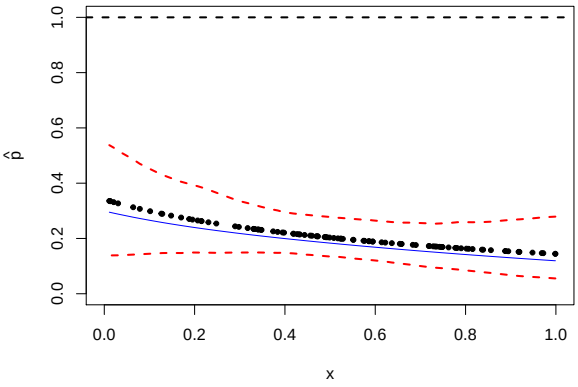
n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 1			Scenario 2		
50	β_{10}	3.00	92.80	4.20	1.00	93.80	5.20
	β_{11}	1.00	88.00	11.00	1.80	93.40	4.80
	β_{20}	1.80	98.20	0.00	3.60	95.80	0.60
	β_{21}	1.60	98.00	0.40	1.00	97.60	1.40
100	β_{10}	2.20	93.60	4.20	1.60	94.00	4.40
	β_{11}	1.80	92.60	5.60	1.20	95.20	3.60
	β_{20}	1.80	97.20	1.00	4.00	94.40	1.60
	β_{21}	2.00	97.20	0.80	2.00	95.00	3.00
200	β_{10}	1.60	93.00	5.40	2.40	92.60	5.00
	β_{11}	1.60	93.20	5.20	2.20	94.00	3.80
	β_{20}	3.20	95.00	1.80	3.80	94.00	2.20
	β_{21}	3.00	95.60	1.40	3.20	93.80	3.00
500	β_{10}	1.20	94.00	4.80	1.00	95.40	3.60
	β_{11}	2.60	94.60	2.80	1.40	96.00	2.60
	β_{20}	2.40	95.20	2.40	3.20	94.80	2.00
	β_{21}	2.60	95.20	2.20	2.40	95.40	2.20

Table 6: Coverage probabilities (%) of the HPDIs using zero-inflated artificial samples (Scenarios 3 and 4).

n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 3			Scenario 4		
50	β_{10}	0.40	95.40	4.20	0.20	96.80	3.00
	β_{11}	3.20	96.40	0.40	2.40	97.00	0.60
	β_{20}	2.20	97.40	0.40	4.60	94.40	1.00
	β_{21}	1.80	97.60	0.60	1.80	94.80	3.40
100	β_{10}	1.40	95.80	2.80	1.20	95.00	3.80
	β_{11}	2.20	96.20	1.60	2.60	95.00	2.40
	β_{20}	2.40	97.40	0.20	4.20	94.60	1.20
	β_{21}	1.80	97.60	0.60	1.80	93.60	4.60
200	β_{10}	2.00	94.40	3.60	1.20	96.60	2.20
	β_{11}	3.20	95.00	1.80	1.80	97.00	1.20
	β_{20}	2.20	96.20	1.60	3.20	95.80	1.00
	β_{21}	2.80	95.60	1.60	2.40	94.40	3.20
500	β_{10}	2.20	94.40	3.40	2.20	95.80	2.00
	β_{11}	2.40	94.80	2.80	2.40	95.40	2.20
	β_{20}	3.80	94.40	1.80	2.20	95.00	2.80
	β_{21}	2.80	95.20	2.00	3.40	94.60	2.00



(a) $n = 50$



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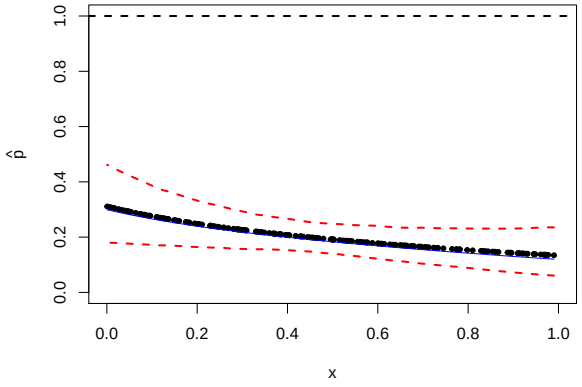
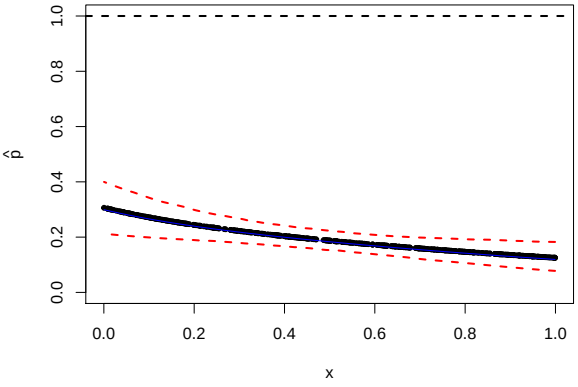
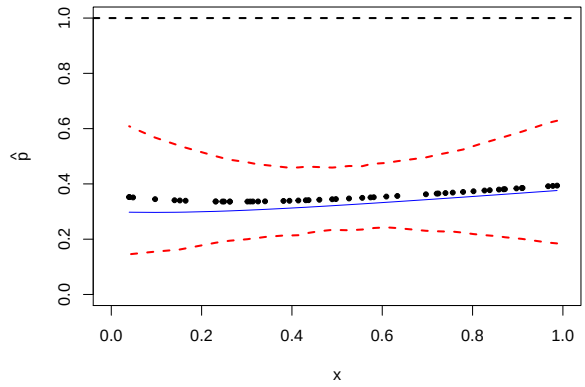


(c) $n = 200$

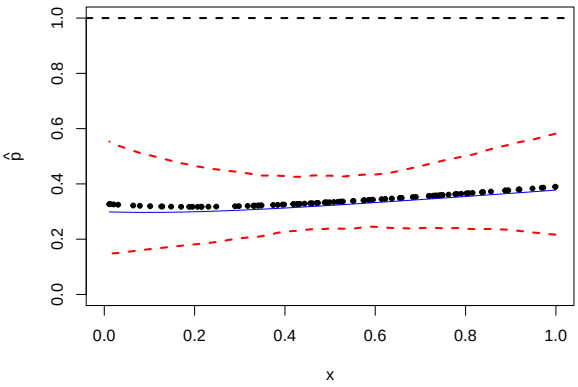


(d) $n = 500$

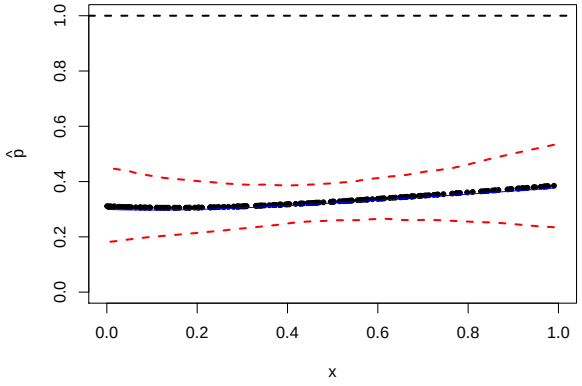
Figure 1: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 1).



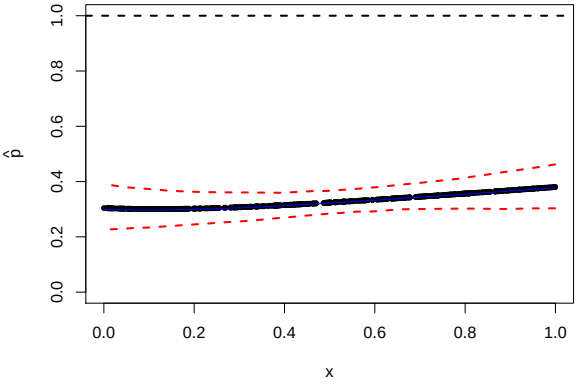
(a) $n = 50$



(b) $n = 100$

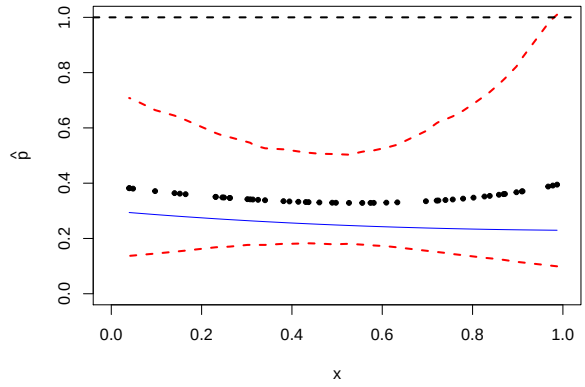


(c) $n = 200$

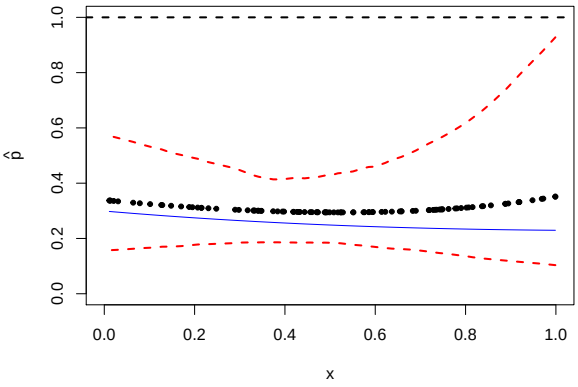


(d) $n = 500$

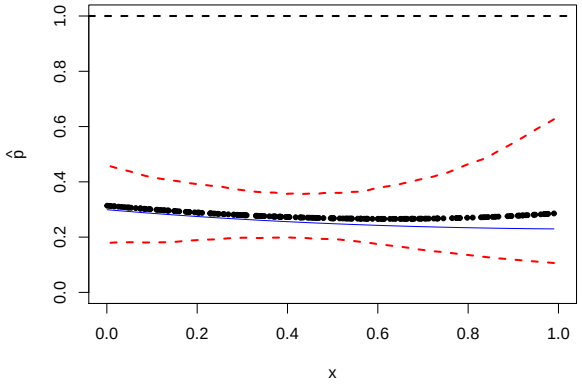
Figure 2: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 2).



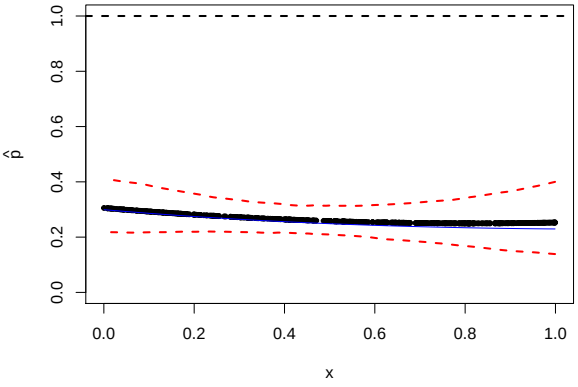
(a) $n = 50$



(b) $n = 100$

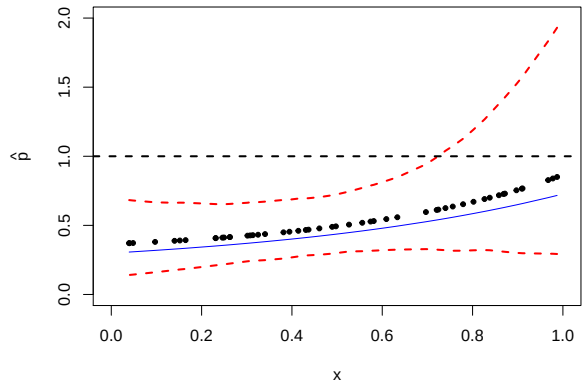


(c) $n = 200$

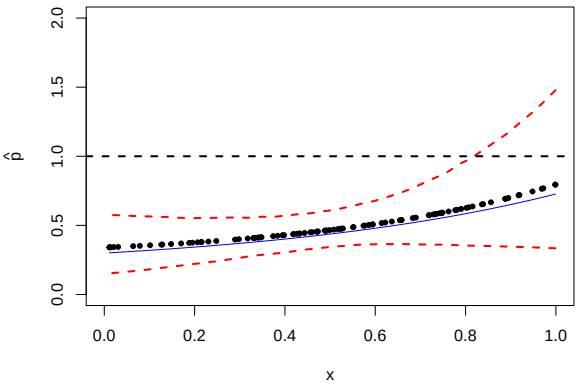


(d) $n = 500$

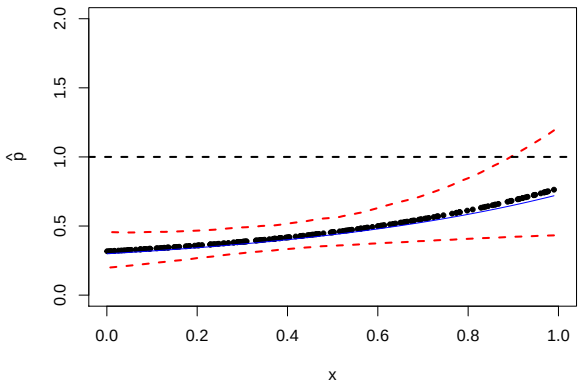
Figure 3: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 3).



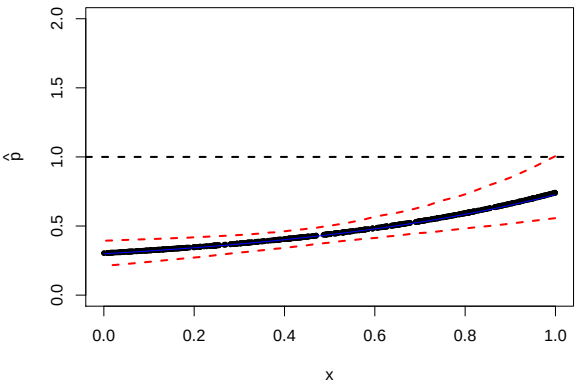
(a) $n = 50$



(b) $n = 100$



(c) $n = 200$



(d) $n = 500$

Figure 4: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 4).

1.2 Using *probit* link function

Table 7: Empirical properties of the Bayesian estimators using zero-inflated artificial samples (Scenarios 1 and 2).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 1		
50	β_{10}	−0.013	0.992	1.000	49.716
	β_{11}	−1.969	9.844	1.284	81.167
	β_{20}	0.020	0.214	1.001	36.875
	β_{21}	0.191	0.754	1.025	69.121
100	β_{10}	−0.007	0.415	1.000	32.842
	β_{11}	−0.847	3.051	1.144	42.982
	β_{20}	0.003	0.148	1.000	30.516
	β_{21}	0.063	0.564	1.004	59.161
200	β_{10}	−0.010	0.134	1.000	18.566
	β_{11}	−0.405	1.003	1.093	24.666
	β_{20}	0.009	0.054	1.001	18.170
	β_{21}	0.010	0.266	1.000	40.134
500	β_{10}	−0.005	0.052	1.000	12.110
	β_{11}	−0.138	0.236	1.043	12.837
	β_{20}	0.001	0.025	1.000	12.704
	β_{21}	0.004	0.096	1.000	24.369
			Scenario 2		
50	β_{10}	−0.213	0.299	1.086	27.133
	β_{11}	−0.117	0.586	1.012	19.488
	β_{20}	0.052	0.180	1.008	33.672
	β_{21}	−0.026	0.497	1.001	108.882
100	β_{10}	−0.131	0.143	1.066	19.972
	β_{11}	−0.026	0.292	1.001	14.063
	β_{20}	0.003	0.108	1.000	26.370
	β_{21}	−0.002	0.311	1.000	89.775
200	β_{10}	−0.056	0.055	1.030	12.321
	β_{11}	−0.018	0.121	1.001	9.102
	β_{20}	−0.002	0.035	1.000	15.016
	β_{21}	0.006	0.114	1.000	54.306
500	β_{10}	−0.030	0.024	1.020	8.184
	β_{11}	0.004	0.052	1.000	6.078
	β_{20}	0.003	0.016	1.000	10.023
	β_{21}	−0.004	0.043	1.000	32.685

Table 8: Empirical properties of the Bayesian estimators using zero-inflated artificial samples (Scenarios 3 and 4).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 3		
50	β_{10}	−0.558	1.168	1.167	54.835
	β_{11}	0.371	2.334	1.031	81.328
	β_{20}	0.064	0.217	1.009	37.291
	β_{21}	0.090	0.739	1.006	69.044
100	β_{10}	−0.335	0.687	1.093	41.996
	β_{11}	0.157	2.126	1.006	79.353
	β_{20}	0.000	0.142	1.000	29.447
	β_{21}	0.085	0.498	1.007	54.999
200	β_{10}	−0.131	0.215	1.042	23.877
	β_{11}	−0.013	1.186	1.000	57.991
	β_{20}	0.008	0.057	1.001	18.644
	β_{21}	0.024	0.260	1.001	39.806
500	β_{10}	−0.043	0.078	1.012	14.353
	β_{11}	−0.058	0.534	1.003	37.506
	β_{20}	0.007	0.022	1.001	11.511
	β_{21}	−0.001	0.092	1.000	23.509
			Scenario 4		
50	β_{10}	−0.300	0.621	1.081	39.539
	β_{11}	0.201	1.467	1.014	64.091
	β_{20}	0.101	0.173	1.031	33.391
	β_{21}	−0.119	0.464	1.016	107.901
100	β_{10}	−0.116	0.306	1.023	28.224
	β_{11}	0.066	0.849	1.003	47.504
	β_{20}	−0.017	0.099	1.002	24.656
	β_{21}	0.045	0.269	1.004	82.445
200	β_{10}	−0.089	0.115	1.036	17.815
	β_{11}	0.058	0.372	1.005	32.020
	β_{20}	0.001	0.042	1.000	16.520
	β_{21}	0.016	0.132	1.001	57.849
500	β_{10}	−0.026	0.041	1.008	10.693
	β_{11}	0.001	0.136	1.000	19.688
	β_{20}	0.000	0.015	1.000	9.807
	β_{21}	0.014	0.042	1.002	33.297

Table 9: *Posterior* estimates for model parameters using zero-inflated artificial samples (Scenarios 1 and 2).

n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
Scenario 1						
50	β_{10}	1.487	1.490	0.996	−0.136	3.104
	β_{11}	1.031	1.022	2.442	−2.290	4.386
	β_{20}	−0.980	−0.964	0.462	−1.971	−0.013
	β_{21}	−0.809	−0.784	0.847	−2.737	1.072
100	β_{10}	1.493	1.495	0.644	0.330	2.654
	β_{11}	2.153	2.141	1.527	−0.182	4.495
	β_{20}	−0.997	−0.988	0.384	−1.754	−0.256
	β_{21}	−0.937	−0.926	0.748	−2.419	0.521
200	β_{10}	1.490	1.491	0.367	0.818	2.158
	β_{11}	2.595	2.585	0.916	1.128	4.080
	β_{20}	−0.991	−0.988	0.233	−1.458	−0.528
	β_{21}	−0.990	−0.980	0.516	−2.004	0.015
500	β_{10}	1.495	1.495	0.228	1.078	1.911
	β_{11}	2.862	2.857	0.465	2.022	3.707
	β_{20}	−0.999	−0.998	0.158	−1.300	−0.701
	β_{21}	−0.996	−0.993	0.310	−1.602	−0.392
Scenario 2						
50	β_{10}	1.287	1.286	0.504	0.339	2.232
	β_{11}	2.883	2.876	0.757	1.478	4.296
	β_{20}	−0.948	−0.939	0.421	−1.767	−0.139
	β_{21}	0.474	0.470	0.704	−0.863	1.819
100	β_{10}	1.369	1.369	0.355	0.656	2.079
	β_{11}	2.974	2.970	0.540	1.887	4.067
	β_{20}	−0.997	−0.992	0.328	−1.623	−0.380
	β_{21}	0.498	0.495	0.558	−0.536	1.537
200	β_{10}	1.444	1.443	0.227	0.991	1.897
	β_{11}	2.982	2.979	0.347	2.265	3.701
	β_{20}	−1.002	−1.000	0.188	−1.395	−0.612
	β_{21}	0.506	0.505	0.338	−0.186	1.199
500	β_{10}	1.470	1.470	0.152	1.176	1.763
	β_{11}	3.004	3.003	0.228	2.568	3.443
	β_{20}	−0.997	−0.996	0.124	−1.252	−0.742
	β_{21}	0.496	0.496	0.207	0.077	0.917

Table 10: *Posterior* estimates for model parameters using zero-inflated artificial samples (Scenarios 3 and 4).

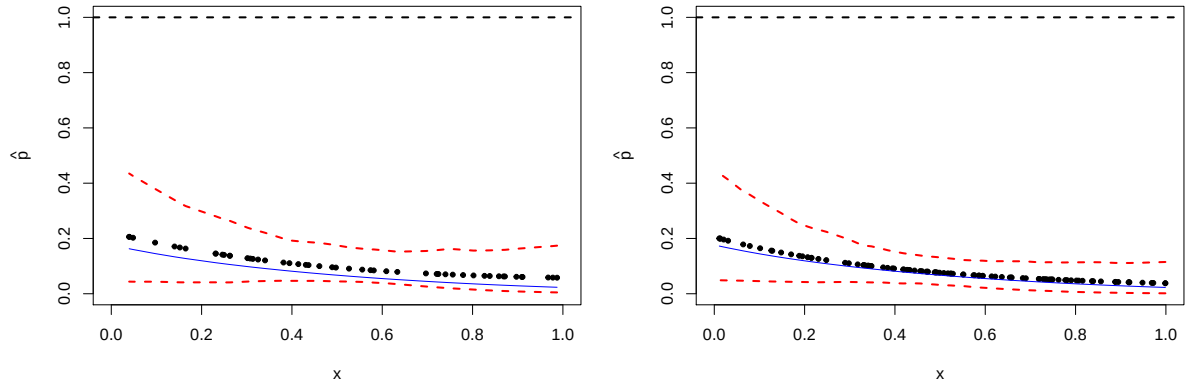
n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
			Scenario 3			
50	β_{10}	0.942	0.961	0.926	−1.084	2.925
	β_{11}	−1.129	−1.127	1.482	−5.479	3.199
	β_{20}	−0.936	−0.922	0.462	−1.922	0.025
	β_{21}	−0.910	−0.880	0.855	−2.863	0.986
100	β_{10}	1.165	1.180	0.758	−0.395	2.695
	β_{11}	−1.343	−1.338	1.450	−4.798	2.099
	β_{20}	−1.000	−0.991	0.377	−1.757	−0.260
	β_{21}	−0.915	−0.904	0.701	−2.390	0.539
200	β_{10}	1.369	1.375	0.445	0.502	2.224
	β_{11}	−1.513	−1.501	1.089	−3.844	0.809
	β_{20}	−0.992	−0.989	0.238	−1.458	−0.532
	β_{21}	−0.976	−0.966	0.510	−1.984	0.019
500	β_{10}	1.457	1.459	0.275	0.921	1.986
	β_{11}	−1.558	−1.551	0.728	−2.976	−0.152
	β_{20}	−0.993	−0.991	0.149	−1.293	−0.694
	β_{21}	−1.001	−0.998	0.304	−1.605	−0.399
			Scenario 4			
50	β_{10}	1.200	1.211	0.729	−0.199	2.576
	β_{11}	−1.299	−1.292	1.194	−3.770	1.162
	β_{20}	−0.899	−0.891	0.404	−1.710	−0.099
	β_{21}	0.381	0.379	0.670	−0.951	1.720
100	β_{10}	1.384	1.390	0.541	0.325	2.433
	β_{11}	−1.434	−1.431	0.919	−3.288	0.421
	β_{20}	−1.017	−1.013	0.314	−1.644	−0.396
	β_{21}	0.545	0.542	0.517	−0.490	1.587
200	β_{10}	1.411	1.414	0.327	0.772	2.041
	β_{11}	−1.442	−1.440	0.607	−2.652	−0.232
	β_{20}	−0.999	−0.997	0.205	−1.392	−0.610
	β_{21}	0.516	0.516	0.363	−0.175	1.208
500	β_{10}	1.474	1.476	0.200	1.069	1.878
	β_{11}	−1.499	−1.498	0.369	−2.223	−0.776
	β_{20}	−1.000	−0.999	0.122	−1.254	−0.745
	β_{21}	0.514	0.513	0.204	0.095	0.933

Table 11: Coverage probabilities (%) of the HPDIs using zero-inflated artificial samples (Scenarios 1 and 2).

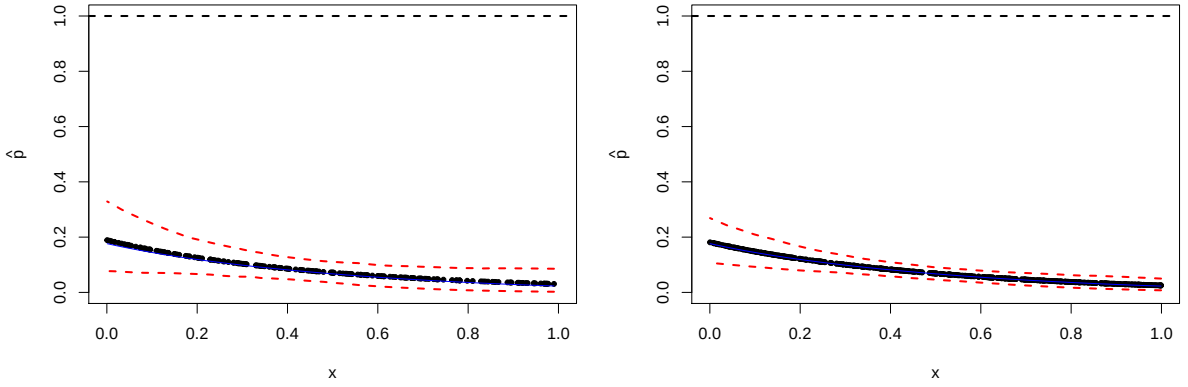
n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 1			Scenario 2		
50	β_{10}	2.60	94.60	2.80	1.20	93.20	5.60
	β_{11}	0.80	73.80	25.40	1.60	93.60	4.80
	β_{20}	2.40	97.40	0.20	5.20	93.80	1.00
	β_{21}	2.40	97.60	0.00	1.60	95.20	3.20
100	β_{10}	2.00	96.20	1.80	1.20	95.40	3.40
	β_{11}	0.40	87.00	12.60	1.20	95.20	3.60
	β_{20}	4.20	94.60	1.20	3.40	95.00	1.60
	β_{21}	3.00	95.80	1.20	3.00	93.80	3.20
200	β_{10}	4.20	92.40	3.40	1.00	95.20	3.80
	β_{11}	0.60	90.00	9.40	1.60	95.60	2.80
	β_{20}	3.20	94.80	2.00	2.00	96.40	1.60
	β_{21}	3.40	95.40	1.20	1.80	96.60	1.60
500	β_{10}	3.40	95.20	1.40	2.80	93.60	3.60
	β_{11}	1.00	92.60	6.40	1.60	95.00	3.40
	β_{20}	2.80	95.20	2.00	2.20	96.40	1.40
	β_{21}	2.60	95.40	2.00	2.20	95.60	2.20

Table 12: Coverage probabilities (%) of the HPDIs using zero-inflated artificial samples (Scenarios 3 and 4).

n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 3			Scenario 4		
50	β_{10}	0.00	98.60	1.40	1.00	96.40	2.60
	β_{11}	0.60	99.40	0.00	2.80	96.40	0.80
	β_{20}	3.20	96.80	0.00	4.40	94.80	0.80
	β_{21}	2.40	97.00	0.60	1.20	94.40	4.40
100	β_{10}	0.40	98.00	1.60	2.60	96.00	1.40
	β_{11}	1.00	98.60	0.40	1.00	97.40	1.60
	β_{20}	2.60	96.60	0.80	1.60	97.20	1.20
	β_{21}	3.80	95.40	0.80	2.00	96.60	1.40
200	β_{10}	0.40	96.60	3.00	1.80	95.60	2.60
	β_{11}	1.20	98.00	0.80	2.20	96.20	1.60
	β_{20}	3.00	95.00	2.00	2.60	96.20	1.20
	β_{21}	3.80	95.80	0.40	1.60	95.40	3.00
500	β_{10}	1.80	96.20	2.00	2.20	96.00	1.80
	β_{11}	2.00	95.60	2.40	2.00	95.60	2.40
	β_{20}	3.20	94.80	2.00	2.80	95.60	1.60
	β_{21}	1.80	96.40	1.80	2.00	96.20	1.80

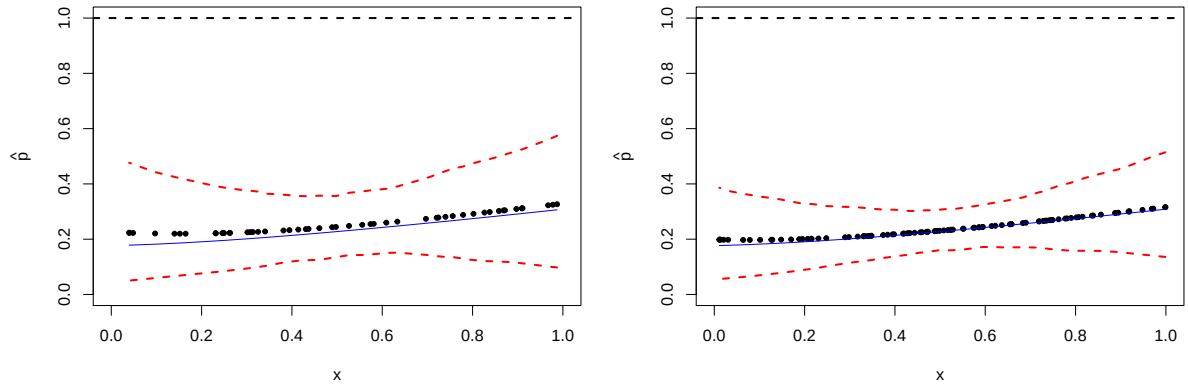


(a) $n = 50$ (b) $n = 100$

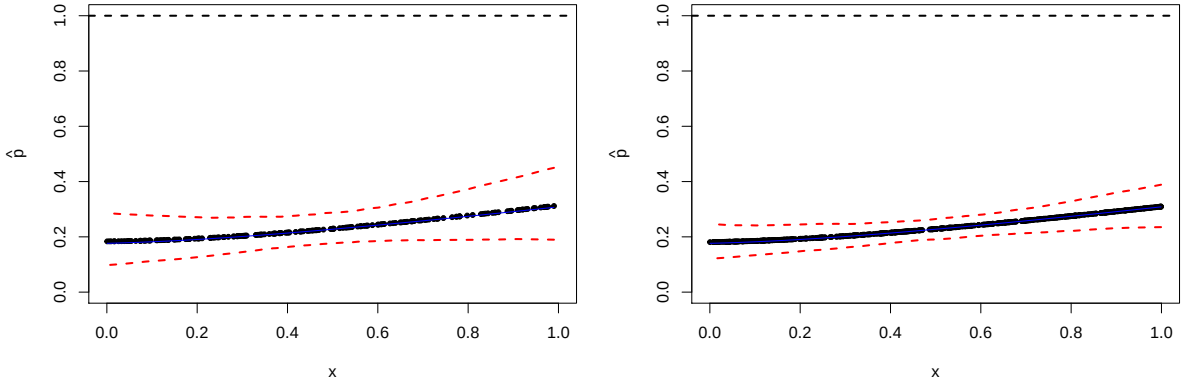


(c) $n = 200$ (d) $n = 500$

Figure 5: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 1).

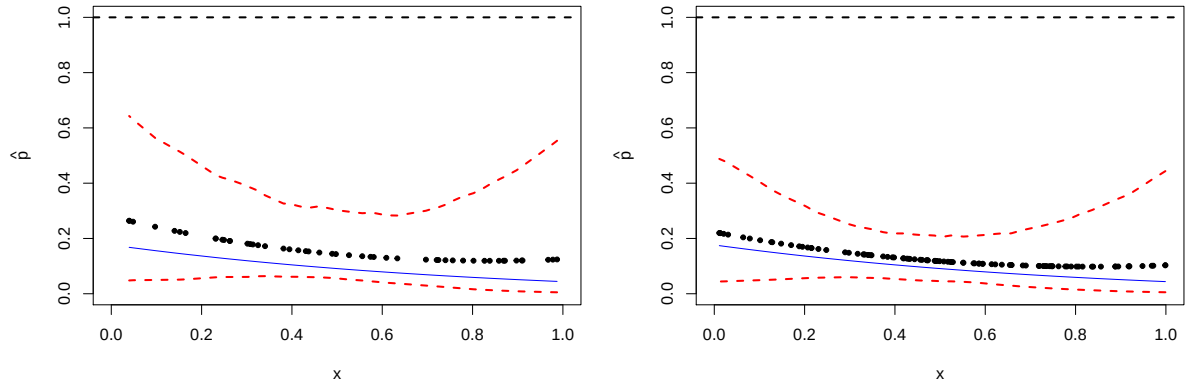


(a) $n = 50$ (b) $n = 100$

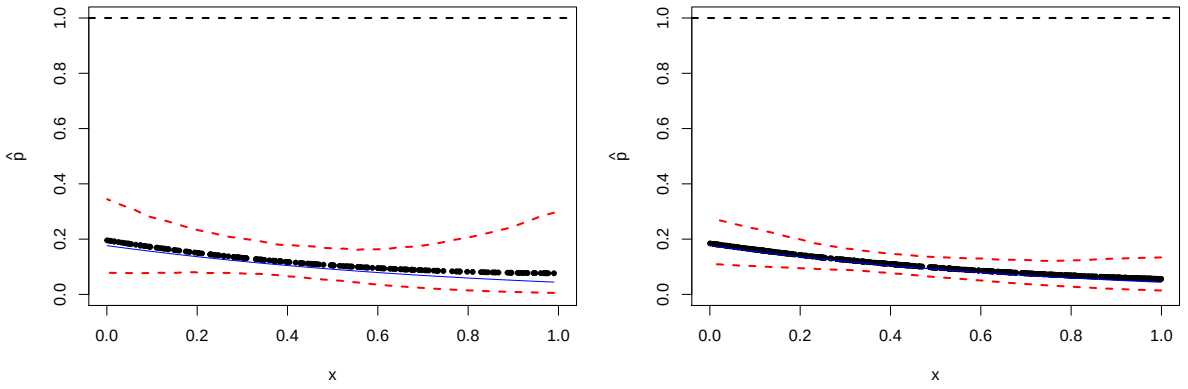


(c) $n = 200$ (d) $n = 500$

Figure 6: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 2).

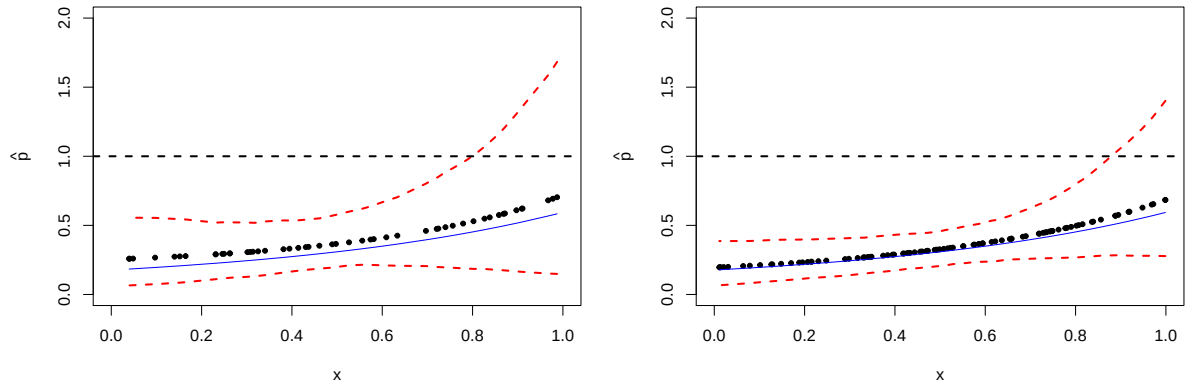


(a) $n = 50$ (b) $n = 100$

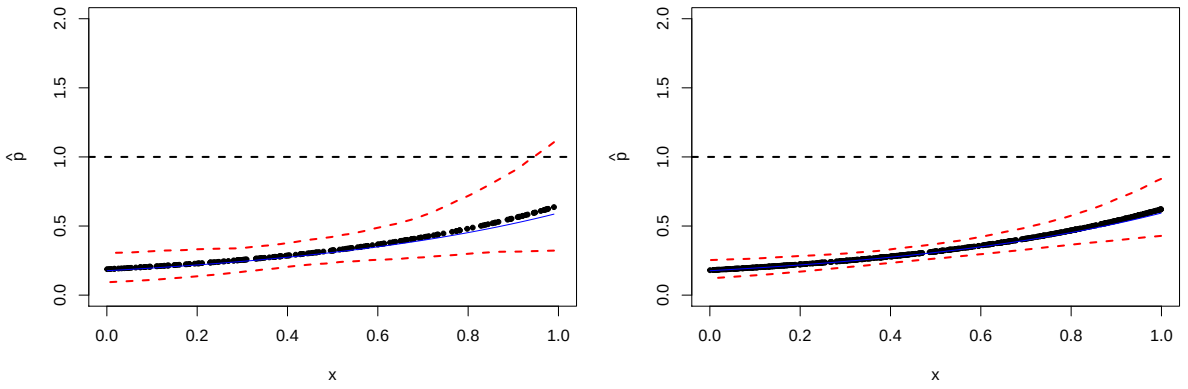


(c) $n = 200$ (d) $n = 500$

Figure 7: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 3).



(a) $n = 50$ (b) $n = 100$



(c) $n = 200$ (d) $n = 500$

Figure 8: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 4).

1.3 Using *complementary log-log* link function

Table 13: Empirical properties of the Bayesian estimators using zero-inflated artificial samples (Scenarios 1 and 2).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 1		
50	β_{10}	−0.145	0.290	1.038	27.436
	β_{11}	−0.369	1.254	1.059	26.086
	β_{20}	0.028	0.260	1.002	40.885
	β_{21}	0.222	0.816	1.032	72.841
100	β_{10}	−0.090	0.132	1.032	19.110
	β_{11}	−0.148	0.415	1.028	16.902
	β_{20}	0.015	0.183	1.001	35.014
	β_{21}	0.122	0.604	1.012	61.264
200	β_{10}	−0.022	0.047	1.005	11.434
	β_{11}	−0.107	0.185	1.032	11.402
	β_{20}	0.018	0.074	1.002	21.593
	β_{21}	0.060	0.296	1.006	42.673
500	β_{10}	−0.011	0.018	1.003	7.083
	β_{11}	−0.038	0.061	1.012	6.449
	β_{20}	0.005	0.031	1.000	13.982
	β_{21}	0.025	0.116	1.003	26.966
			Scenario 2		
50	β_{10}	−0.116	0.164	1.044	20.395
	β_{11}	−0.179	0.375	1.046	15.972
	β_{20}	0.098	0.243	1.020	39.207
	β_{21}	−0.083	0.657	1.005	127.997
100	β_{10}	−0.060	0.074	1.026	14.508
	β_{11}	−0.106	0.192	1.030	11.570
	β_{20}	0.039	0.129	1.006	28.591
	β_{21}	−0.018	0.357	1.000	96.053
200	β_{10}	−0.052	0.034	1.042	9.499
	β_{11}	−0.015	0.082	1.001	7.587
	β_{20}	0.022	0.054	1.004	18.028
	β_{21}	−0.021	0.154	1.001	61.469
500	β_{10}	−0.017	0.012	1.012	5.755
	β_{11}	−0.004	0.028	1.000	4.473
	β_{20}	0.006	0.023	1.001	12.253
	β_{21}	0.000	0.062	1.000	40.099

Table 14: Empirical properties of the Bayesian estimators using zero-inflated artificial samples (Scenarios 3 and 4).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 3		
50	β_{10}	−0.286	0.547	1.085	36.060
	β_{11}	0.242	1.647	1.018	67.210
	β_{20}	0.026	0.281	1.001	41.631
	β_{21}	0.248	0.961	1.034	78.137
100	β_{10}	−0.108	0.245	1.025	24.112
	β_{11}	−0.014	0.921	1.000	49.679
	β_{20}	0.010	0.174	1.000	33.560
	β_{21}	0.120	0.569	1.013	60.454
200	β_{10}	−0.055	0.083	1.019	14.855
	β_{11}	−0.023	0.442	1.001	34.941
	β_{20}	0.012	0.072	1.001	21.081
	β_{21}	0.036	0.278	1.002	41.432
500	β_{10}	−0.024	0.033	1.008	9.631
	β_{11}	−0.024	0.166	1.002	21.483
	β_{20}	0.002	0.032	1.000	14.379
	β_{21}	0.014	0.110	1.001	26.533
			Scenario 4		
50	β_{10}	−0.232	0.352	1.087	29.729
	β_{11}	0.165	0.972	1.014	52.225
	β_{20}	0.048	0.209	1.006	37.053
	β_{21}	−0.007	0.550	1.000	117.533
100	β_{10}	−0.116	0.147	1.049	20.012
	β_{11}	0.078	0.434	1.007	34.804
	β_{20}	0.037	0.125	1.006	28.175
	β_{21}	−0.017	0.331	1.000	92.817
200	β_{10}	−0.043	0.066	1.014	13.459
	β_{11}	0.017	0.265	1.000	26.876
	β_{20}	0.029	0.054	1.008	18.318
	β_{21}	−0.031	0.174	1.003	65.728
500	β_{10}	−0.006	0.022	1.001	7.707
	β_{11}	−0.015	0.078	1.001	14.695
	β_{20}	0.005	0.022	1.001	11.691
	β_{21}	−0.012	0.059	1.001	38.117

Table 15: *Posterior* estimates for model parameters using zero-inflated artificial samples (Scenarios 1 and 2).

n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
Scenario 1						
50	β_{10}	1.355	1.355	0.519	0.438	2.270
	β_{11}	2.631	2.620	1.057	1.022	4.252
	β_{20}	−0.972	−0.945	0.510	−2.072	0.088
	β_{21}	−0.778	−0.768	0.876	−2.783	1.212
100	β_{10}	1.410	1.411	0.352	0.740	2.079
	β_{11}	2.852	2.844	0.627	1.679	4.037
	β_{20}	−0.985	−0.969	0.427	−1.837	−0.159
	β_{21}	−0.878	−0.877	0.767	−2.449	0.681
200	β_{10}	1.478	1.478	0.216	1.073	1.886
	β_{11}	2.893	2.889	0.417	2.131	3.662
	β_{20}	−0.982	−0.975	0.271	−1.518	−0.454
	β_{21}	−0.940	−0.935	0.541	−2.034	0.147
500	β_{10}	1.489	1.489	0.135	1.226	1.752
	β_{11}	2.962	2.961	0.243	2.500	3.423
	β_{20}	−0.995	−0.992	0.176	−1.348	−0.648
	β_{21}	−0.975	−0.974	0.339	−1.645	−0.307
Scenario 2						
50	β_{10}	1.384	1.384	0.388	0.688	2.080
	β_{11}	2.821	2.817	0.586	1.763	3.881
	β_{20}	−0.902	−0.882	0.484	−1.844	0.004
	β_{21}	0.417	0.414	0.806	−1.104	1.944
100	β_{10}	1.440	1.440	0.265	0.917	1.964
	β_{11}	2.894	2.892	0.425	2.079	3.714
	β_{20}	−0.961	−0.950	0.357	−1.685	−0.253
	β_{21}	0.482	0.478	0.597	−0.709	1.674
200	β_{10}	1.448	1.448	0.176	1.109	1.786
	β_{11}	2.985	2.983	0.286	2.434	3.537
	β_{20}	−0.978	−0.973	0.232	−1.441	−0.523
	β_{21}	0.479	0.480	0.392	−0.329	1.286
500	β_{10}	1.483	1.483	0.108	1.263	1.704
	β_{11}	2.996	2.995	0.167	2.660	3.333
	β_{20}	−0.994	−0.991	0.152	−1.297	−0.694
	β_{21}	0.500	0.499	0.248	0.009	0.994

Table 16: *Posterior* estimates for model parameters using zero-inflated artificial samples (Scenarios 3 and 4).

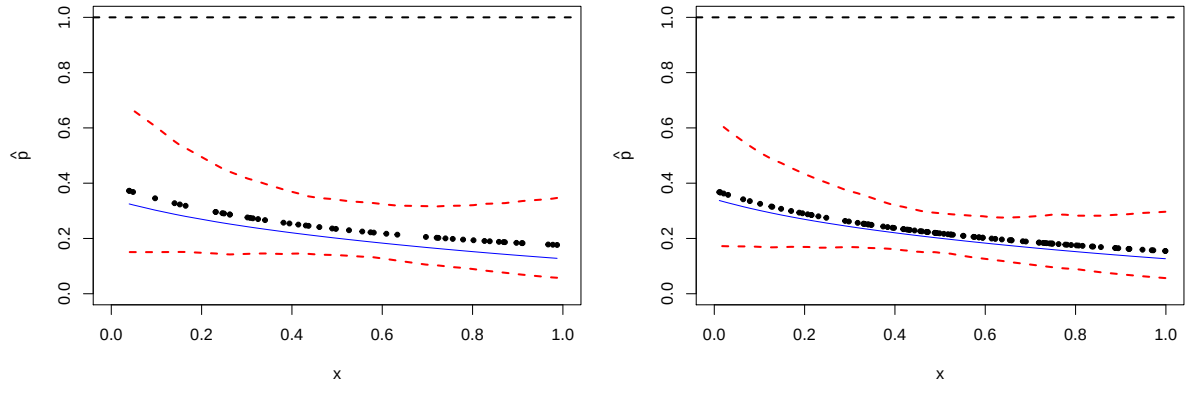
n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
Scenario 3						
50	β_{10}	1.214	1.223	0.682	−0.069	2.474
	β_{11}	−1.258	−1.248	1.260	−3.918	1.391
	β_{20}	−0.974	−0.949	0.530	−2.073	0.081
	β_{21}	−0.752	−0.743	0.949	−2.749	1.224
100	β_{10}	1.392	1.398	0.483	0.477	2.293
	β_{11}	−1.514	−1.510	0.960	−3.446	0.395
	β_{20}	−0.990	−0.974	0.418	−1.845	−0.162
	β_{21}	−0.880	−0.878	0.745	−2.450	0.691
200	β_{10}	1.445	1.447	0.283	0.903	1.986
	β_{11}	−1.523	−1.518	0.664	−2.827	−0.225
	β_{20}	−0.988	−0.981	0.268	−1.530	−0.457
	β_{21}	−0.964	−0.959	0.526	−2.069	0.134
500	β_{10}	1.476	1.478	0.180	1.129	1.821
	β_{11}	−1.524	−1.522	0.407	−2.307	−0.745
	β_{20}	−0.998	−0.995	0.180	−1.350	−0.648
	β_{21}	−0.986	−0.985	0.331	−1.659	−0.315
Scenario 4						
50	β_{10}	1.268	1.275	0.546	0.231	2.295
	β_{11}	−1.335	−1.330	0.972	−3.202	0.524
	β_{20}	−0.952	−0.933	0.455	−1.901	−0.037
	β_{21}	0.493	0.490	0.742	−1.036	2.025
100	β_{10}	1.384	1.389	0.365	0.624	2.141
	β_{11}	−1.422	−1.421	0.654	−2.805	−0.033
	β_{20}	−0.963	−0.951	0.352	−1.690	−0.256
	β_{21}	0.483	0.480	0.575	−0.706	1.677
200	β_{10}	1.457	1.458	0.254	0.990	1.921
	β_{11}	−1.483	−1.482	0.515	−2.415	−0.551
	β_{20}	−0.971	−0.967	0.231	−1.433	−0.517
	β_{21}	0.469	0.469	0.416	−0.337	1.275
500	β_{10}	1.494	1.494	0.146	1.193	1.792
	β_{11}	−1.515	−1.514	0.278	−2.074	−0.957
	β_{20}	−0.995	−0.993	0.146	−1.299	−0.694
	β_{21}	0.488	0.488	0.242	−0.004	0.983

Table 17: Coverage probabilities (%) of the HPDIs using zero-inflated artificial samples (Scenarios 1 and 2).

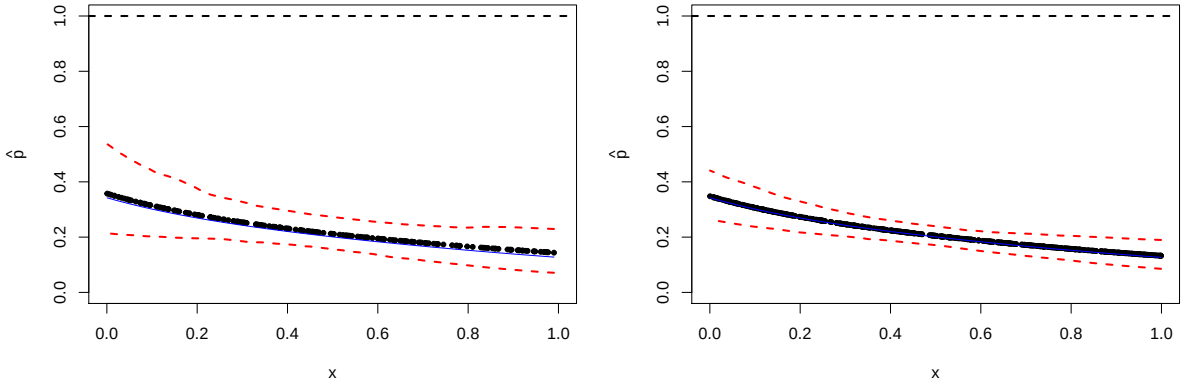
n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 1			Scenario 2		
50	β_{10}	1.60	92.40	6.00	2.00	91.80	6.20
	β_{11}	2.00	89.40	8.60	1.80	91.20	7.00
	β_{20}	4.60	95.20	0.20	6.40	92.60	1.00
	β_{21}	1.80	97.80	0.40	2.20	94.40	3.40
100	β_{10}	1.40	94.60	4.00	2.60	94.60	2.80
	β_{11}	0.40	94.00	5.60	0.80	93.40	5.80
	β_{20}	4.80	94.80	0.40	3.40	95.00	1.60
	β_{21}	3.40	95.40	1.20	1.40	95.00	3.60
200	β_{10}	2.20	94.00	3.80	1.40	94.80	3.80
	β_{11}	1.60	93.40	5.00	1.80	94.80	3.40
	β_{20}	4.60	94.40	1.00	4.40	94.40	1.20
	β_{21}	2.60	96.00	1.40	1.40	95.60	3.00
500	β_{10}	1.80	95.00	3.20	1.00	96.60	2.40
	β_{11}	2.00	93.40	4.60	1.40	96.80	1.80
	β_{20}	2.80	95.20	2.00	2.20	96.80	1.00
	β_{21}	2.80	95.20	2.00	2.20	95.20	2.60

Table 18: Coverage probabilities (%) of the HPDIs using zero-inflated artificial samples (Scenarios 3 and 4).

n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 3			Scenario 4		
50	β_{10}	1.40	93.80	4.80	0.60	95.60	3.80
	β_{11}	2.20	97.00	0.80	3.40	95.60	1.00
	β_{20}	2.20	96.80	1.00	4.00	95.80	0.20
	β_{21}	3.60	96.40	0.00	1.60	96.20	2.20
100	β_{10}	1.40	95.60	3.00	1.20	96.60	2.20
	β_{11}	2.60	95.80	1.60	2.00	96.00	2.00
	β_{20}	4.20	95.00	0.80	3.60	95.40	1.00
	β_{21}	1.80	97.40	0.80	1.00	97.00	2.00
200	β_{10}	2.40	95.20	2.40	1.80	94.00	4.20
	β_{11}	1.80	96.20	2.00	3.40	93.40	3.20
	β_{20}	2.60	95.80	1.60	2.60	96.20	1.20
	β_{21}	2.80	96.20	1.00	2.40	94.60	3.00
500	β_{10}	2.20	94.40	3.40	3.00	94.80	2.20
	β_{11}	2.00	95.20	2.80	1.40	95.40	3.20
	β_{20}	3.40	94.80	1.80	2.80	96.20	1.00
	β_{21}	1.60	96.60	1.80	1.80	95.40	2.80

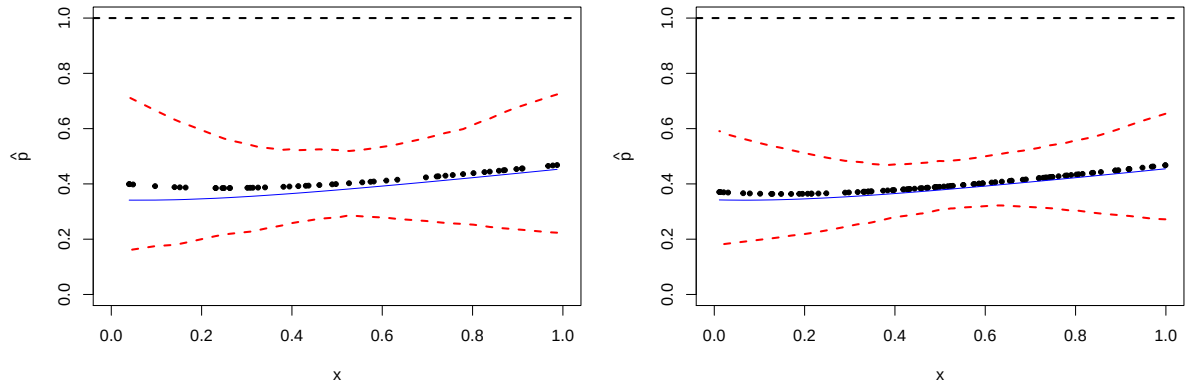


(a) $n = 50$ (b) $n = 100$

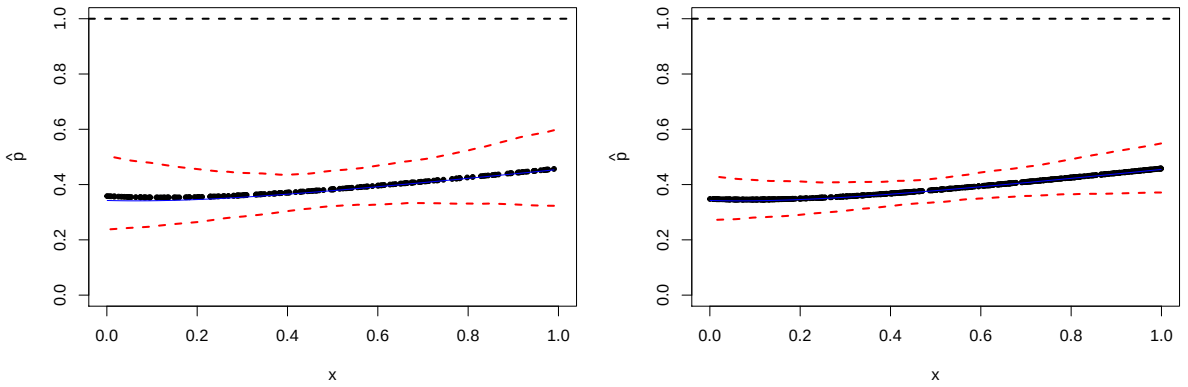


(c) $n = 200$ (d) $n = 500$

Figure 9: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 1).

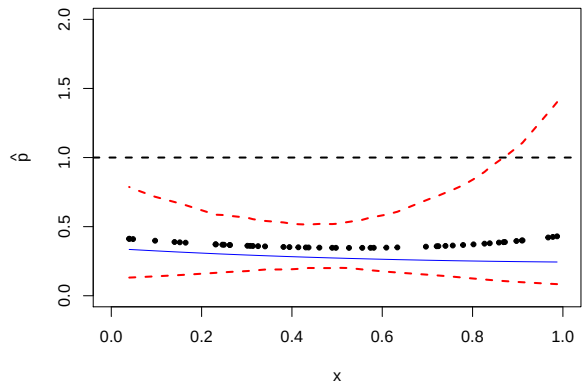


(a) $n = 50$ (b) $n = 100$

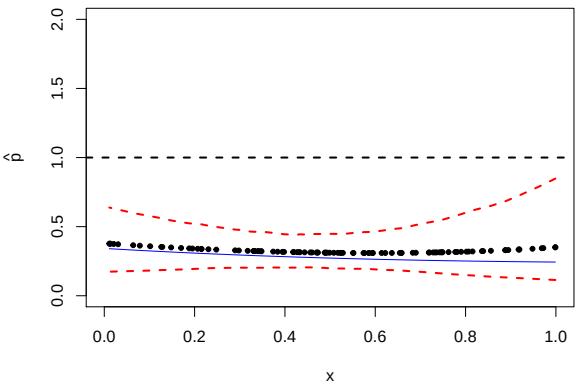


(c) $n = 200$ (d) $n = 500$

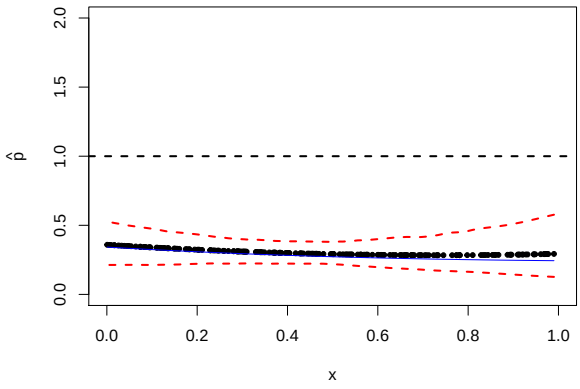
Figure 10: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 2).



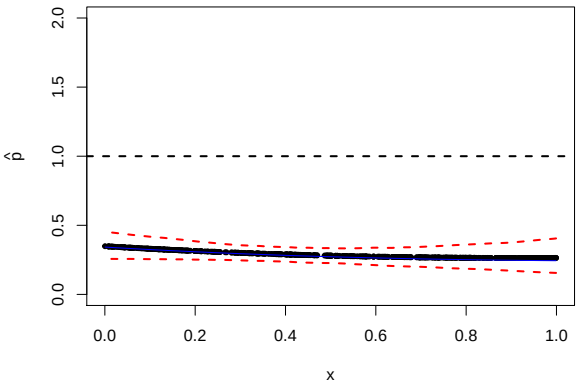
(a) $n = 50$



(b) $n = 100$

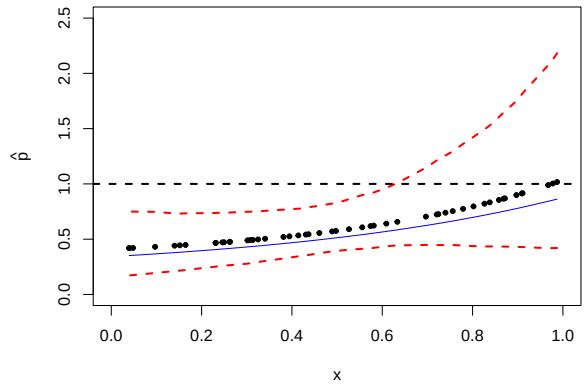


(c) $n = 200$

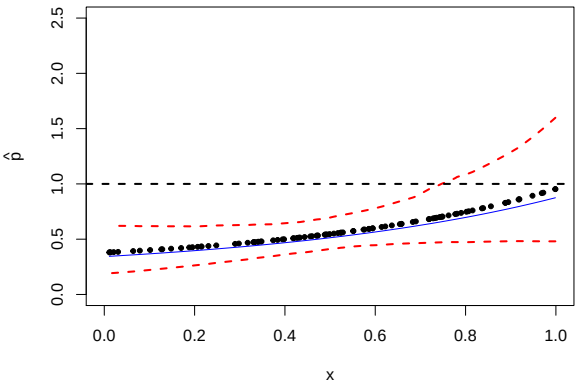


(d) $n = 500$

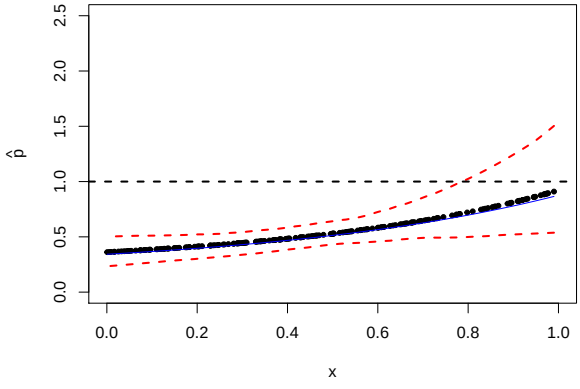
Figure 11: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 3).



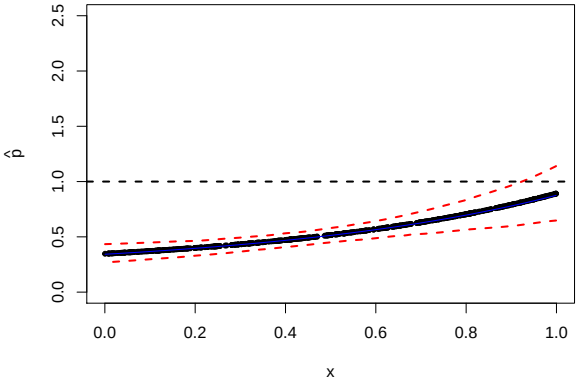
(a) $n = 50$



(b) $n = 100$



(c) $n = 200$



(d) $n = 500$

Figure 12: *Posterior* estimates for parameter p using zero-inflated artificial samples (Scenario 4).

2 Zero-deflated artificial data

2.1 Using *logit* link function

Table 19: Empirical properties of the Bayesian estimators using zero-deflated artificial samples (Scenarios 1 and 2).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 1		
50	β_{10}	0.116	0.342	1.020	46.269
	β_{11}	−0.209	0.905	1.025	75.544
	β_{20}	−0.071	0.298	1.008	85.289
	β_{21}	−0.017	0.904	1.000	148.588
100	β_{10}	0.040	0.221	1.004	36.505
	β_{11}	−0.069	0.581	1.004	60.373
	β_{20}	−0.010	0.189	1.000	68.498
	β_{21}	−0.061	0.566	1.003	118.380
200	β_{10}	0.043	0.093	1.010	25.193
	β_{11}	−0.067	0.268	1.008	41.512
	β_{20}	−0.016	0.079	1.002	44.834
	β_{21}	−0.005	0.277	1.000	85.763
500	β_{10}	−0.004	0.041	1.000	16.515
	β_{11}	0.004	0.105	1.000	25.966
	β_{20}	0.005	0.035	1.000	30.158
	β_{21}	−0.022	0.107	1.002	52.544
			Scenario 2		
50	β_{10}	0.070	0.329	1.007	44.744
	β_{11}	−0.121	0.928	1.008	75.648
	β_{20}	−0.188	0.383	1.050	33.581
	β_{21}	0.144	0.939	1.011	78.153
100	β_{10}	0.040	0.185	1.004	33.702
	β_{11}	−0.075	0.508	1.006	56.059
	β_{20}	−0.069	0.251	1.010	27.134
	β_{21}	0.028	0.648	1.001	64.126
200	β_{10}	0.004	0.082	1.000	22.578
	β_{11}	−0.007	0.269	1.000	41.316
	β_{20}	−0.066	0.099	1.023	16.943
	β_{21}	0.074	0.297	1.010	43.689
500	β_{10}	0.013	0.038	1.002	15.487
	β_{11}	−0.021	0.100	1.002	25.244
	β_{20}	−0.022	0.045	1.006	11.579
	β_{21}	0.018	0.121	1.001	27.868

Table 20: Empirical properties of the Bayesian estimators using zero-deflated artificial samples (Scenarios 3 and 4).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 3		
50	β_{10}	0.007	0.416	1.000	51.077
	β_{11}	0.578	1.484	1.136	63.871
	β_{20}	−0.046	0.298	1.004	88.854
	β_{21}	−0.032	0.908	1.000	156.233
100	β_{10}	0.004	0.320	1.000	45.682
	β_{11}	0.249	1.085	1.030	55.080
	β_{20}	−0.039	0.198	1.004	70.640
	β_{21}	−0.012	0.563	1.000	120.764
200	β_{10}	0.001	0.155	1.000	31.560
	β_{11}	0.142	0.607	1.017	41.578
	β_{20}	−0.023	0.080	1.003	45.237
	β_{21}	−0.004	0.265	1.000	81.871
500	β_{10}	−0.006	0.064	1.000	20.189
	β_{11}	0.077	0.237	1.013	25.468
	β_{20}	−0.002	0.033	1.000	28.544
	β_{21}	−0.009	0.098	1.000	49.648
			Scenario 4		
50	β_{10}	−0.009	0.356	1.000	47.455
	β_{11}	0.562	1.376	1.139	62.652
	β_{20}	−0.126	0.372	1.022	32.045
	β_{21}	0.058	1.017	1.002	80.557
100	β_{10}	−0.053	0.294	1.005	42.976
	β_{11}	0.366	1.155	1.064	56.965
	β_{20}	−0.103	0.239	1.023	26.300
	β_{21}	0.113	0.650	1.010	65.186
200	β_{10}	0.012	0.113	1.001	27.492
	β_{11}	0.154	0.530	1.023	39.172
	β_{20}	−0.059	0.108	1.016	17.372
	β_{21}	0.070	0.335	1.007	46.286
500	β_{10}	−0.013	0.052	1.002	17.895
	β_{11}	0.086	0.207	1.018	24.165
	β_{20}	−0.013	0.045	1.002	11.191
	β_{21}	0.017	0.122	1.001	27.718

Table 21: *Posterior* estimates for model parameters using zero-deflated artificial samples (Scenarios 1 and 2).

n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
Scenario 1						
50	β_{10}	−0.884	−0.871	0.574	−2.129	0.336
	β_{11}	0.791	0.787	0.928	−1.156	2.737
	β_{20}	0.429	0.423	0.541	−0.722	1.591
	β_{21}	0.483	0.478	0.951	−1.517	2.486
100	β_{10}	−0.960	−0.952	0.469	−1.917	−0.013
	β_{11}	0.931	0.928	0.759	−0.590	2.455
	β_{20}	0.490	0.485	0.435	−0.399	1.387
	β_{21}	0.439	0.437	0.750	−1.119	1.995
200	β_{10}	−0.957	−0.953	0.301	−1.568	−0.351
	β_{11}	0.933	0.933	0.513	−0.086	1.956
	β_{20}	0.484	0.482	0.280	−0.078	1.051
	β_{21}	0.495	0.493	0.526	−0.564	1.554
500	β_{10}	−1.004	−1.003	0.203	−1.408	−0.602
	β_{11}	1.004	1.003	0.324	0.376	1.633
	β_{20}	0.505	0.503	0.187	0.137	0.874
	β_{21}	0.478	0.478	0.327	−0.164	1.121
Scenario 2						
50	β_{10}	−0.930	−0.917	0.569	−2.095	0.212
	β_{11}	0.879	0.878	0.956	−1.013	2.782
	β_{20}	1.312	1.294	0.589	0.063	2.598
	β_{21}	−0.856	−0.848	0.958	−2.945	1.212
100	β_{10}	−0.960	−0.953	0.429	−1.852	−0.080
	β_{11}	0.925	0.923	0.709	−0.548	2.405
	β_{20}	1.431	1.420	0.496	0.445	2.442
	β_{21}	−0.972	−0.964	0.804	−2.626	0.673
200	β_{10}	−0.996	−0.993	0.287	−1.564	−0.431
	β_{11}	0.993	0.993	0.519	−0.001	1.986
	β_{20}	1.434	1.428	0.308	0.800	2.077
	β_{21}	−0.926	−0.923	0.540	−2.041	0.189
500	β_{10}	−0.987	−0.986	0.194	−1.359	−0.618
	β_{11}	0.979	0.979	0.315	0.372	1.587
	β_{20}	1.478	1.475	0.211	1.058	1.902
	β_{21}	−0.982	−0.980	0.347	−1.668	−0.300

Table 22: *Posterior* estimates for model parameters using zero-deflated artificial samples (Scenarios 3 and 4).

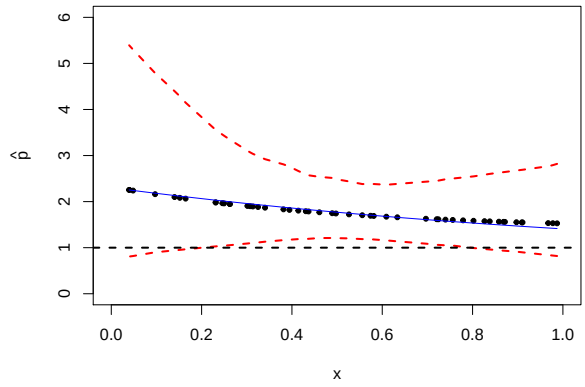
n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
Scenario 3						
50	β_{10}	−0.993	−0.970	0.645	−2.515	0.496
	β_{11}	−0.922	−0.910	1.073	−3.654	1.794
	β_{20}	0.454	0.447	0.544	−0.698	1.624
	β_{21}	0.468	0.463	0.952	−1.546	2.478
100	β_{10}	−0.996	−0.980	0.566	−2.206	0.185
	β_{11}	−1.251	−1.244	1.012	−3.489	0.970
	β_{20}	0.461	0.457	0.443	−0.427	1.356
	β_{21}	0.488	0.486	0.750	−1.067	2.045
200	β_{10}	−0.999	−0.993	0.394	−1.764	−0.242
	β_{11}	−1.359	−1.349	0.766	−2.936	0.204
	β_{20}	0.477	0.476	0.282	−0.086	1.041
	β_{21}	0.496	0.494	0.515	−0.555	1.557
500	β_{10}	−1.006	−1.003	0.252	−1.505	−0.512
	β_{11}	−1.423	−1.419	0.480	−2.388	−0.466
	β_{20}	0.498	0.497	0.182	0.130	0.868
	β_{21}	0.491	0.491	0.312	−0.152	1.134
Scenario 4						
50	β_{10}	−1.009	−0.989	0.596	−2.426	0.373
	β_{11}	−0.938	−0.921	1.030	−3.628	1.734
	β_{20}	1.374	1.355	0.597	0.109	2.667
	β_{21}	−0.942	−0.934	1.007	−3.039	1.143
100	β_{10}	−1.053	−1.040	0.539	−2.169	0.040
	β_{11}	−1.134	−1.127	1.011	−3.277	1.003
	β_{20}	1.397	1.386	0.478	0.412	2.401
	β_{21}	−0.887	−0.880	0.798	−2.538	0.761
200	β_{10}	−0.988	−0.982	0.335	−1.682	−0.302
	β_{11}	−1.346	−1.335	0.711	−2.861	0.154
	β_{20}	1.441	1.436	0.322	0.805	2.084
	β_{21}	−0.930	−0.928	0.574	−2.045	0.189
500	β_{10}	−1.013	−1.010	0.227	−1.468	−0.563
	β_{11}	−1.414	−1.410	0.447	−2.350	−0.485
	β_{20}	1.487	1.484	0.213	1.066	1.912
	β_{21}	−0.983	−0.981	0.348	−1.670	−0.299

Table 23: Coverage probabilities (%) of the HPDIs using zero-deflated artificial samples (Scenarios 1 and 2).

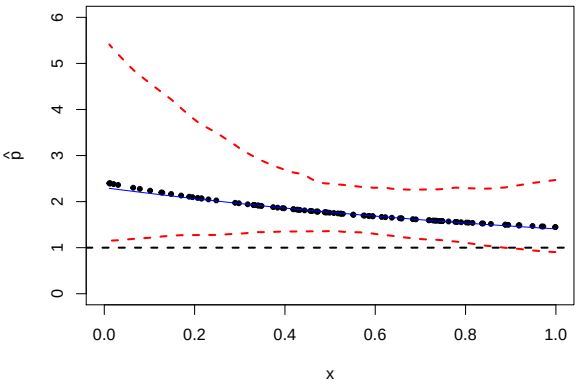
n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 1			Scenario 2		
50	β_{10}	3.40	96.20	0.40	4.40	94.40	1.20
	β_{11}	0.80	96.60	2.60	2.20	95.20	2.60
	β_{20}	0.40	97.00	2.60	0.20	95.60	4.20
	β_{21}	1.40	97.60	1.00	2.40	97.40	0.20
100	β_{10}	3.80	94.60	1.60	2.20	96.80	1.00
	β_{11}	1.60	96.40	2.00	1.60	95.60	2.80
	β_{20}	1.60	96.00	2.40	0.80	95.20	4.00
	β_{21}	1.40	96.20	2.40	2.60	96.00	1.40
200	β_{10}	3.40	96.20	0.40	3.00	95.00	2.00
	β_{11}	1.20	96.60	2.20	3.80	93.60	2.60
	β_{20}	0.80	96.00	3.20	0.80	96.00	3.20
	β_{21}	1.20	97.00	1.80	2.40	96.40	1.20
500	β_{10}	2.20	95.00	2.80	2.60	95.20	2.20
	β_{11}	2.40	94.80	2.80	2.00	95.60	2.40
	β_{20}	0.80	95.80	3.40	1.40	95.20	3.40
	β_{21}	2.40	95.80	1.80	2.80	95.00	2.20

Table 24: Coverage probabilities (%) of the HPDIs using zero-deflated artificial samples (Scenarios 3 and 4).

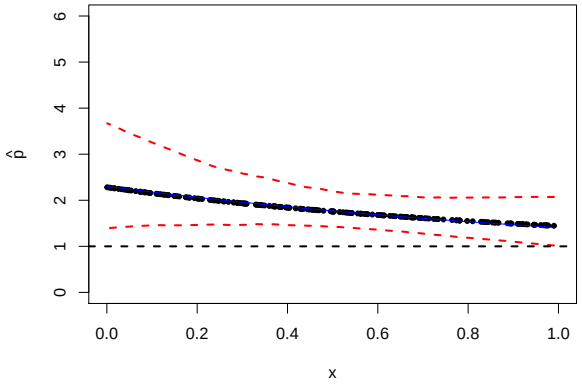
n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 3			Scenario 4		
50	β_{10}	2.20	97.60	0.20	1.40	98.60	0.00
	β_{11}	3.20	96.80	0.00	2.60	97.40	0.00
	β_{20}	0.40	97.60	2.00	1.00	96.00	3.00
	β_{21}	0.80	97.60	1.60	2.00	96.60	1.40
100	β_{10}	2.40	97.00	0.60	1.20	97.60	1.20
	β_{11}	1.80	97.60	0.60	3.40	96.40	0.20
	β_{20}	2.00	95.00	3.00	0.80	94.60	4.60
	β_{21}	1.60	96.40	2.00	2.80	96.20	1.00
200	β_{10}	3.40	94.40	2.20	3.40	95.80	0.80
	β_{11}	4.00	95.20	0.80	2.80	96.20	1.00
	β_{20}	2.20	95.60	2.20	2.00	94.80	3.20
	β_{21}	1.20	96.80	2.00	3.60	94.40	2.00
500	β_{10}	3.40	94.60	2.00	2.20	94.80	3.00
	β_{11}	4.00	94.40	1.60	3.40	95.80	0.80
	β_{20}	2.20	94.60	3.20	1.20	95.20	3.60
	β_{21}	1.40	96.80	1.80	3.20	95.40	1.40



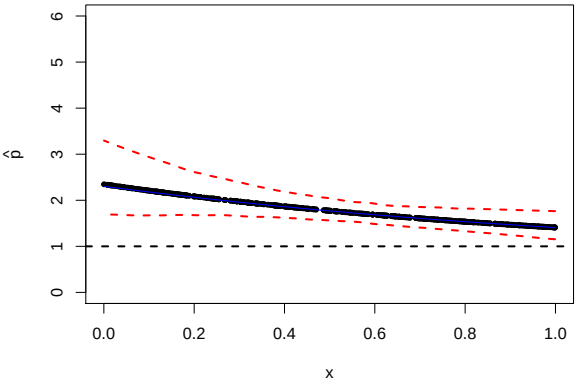
(a) $n = 50$



(b) $n = 100$

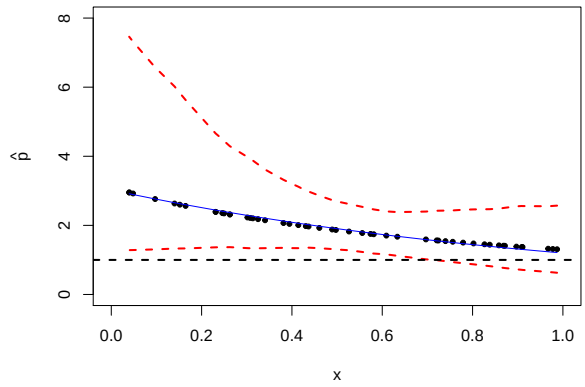


(c) $n = 200$

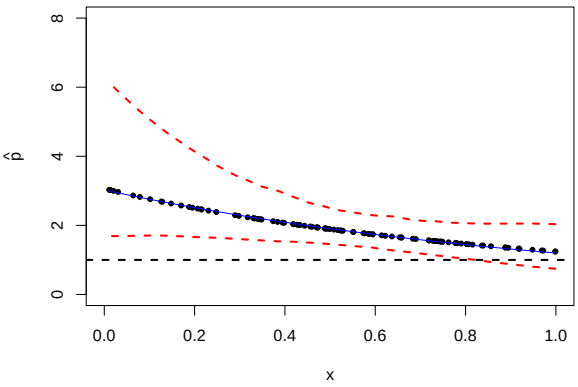


(d) $n = 500$

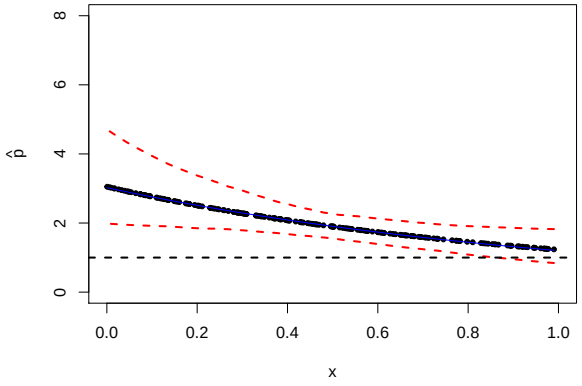
Figure 13: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 1).



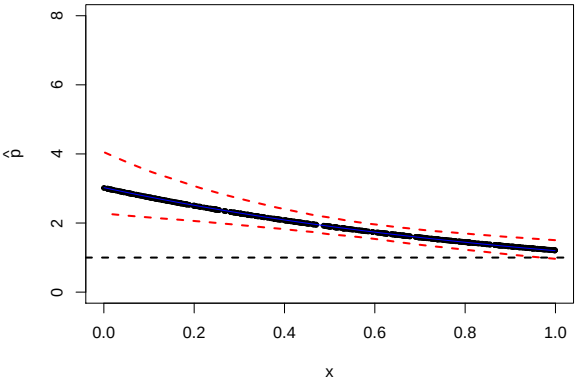
(a) $n = 50$



(b) $n = 100$

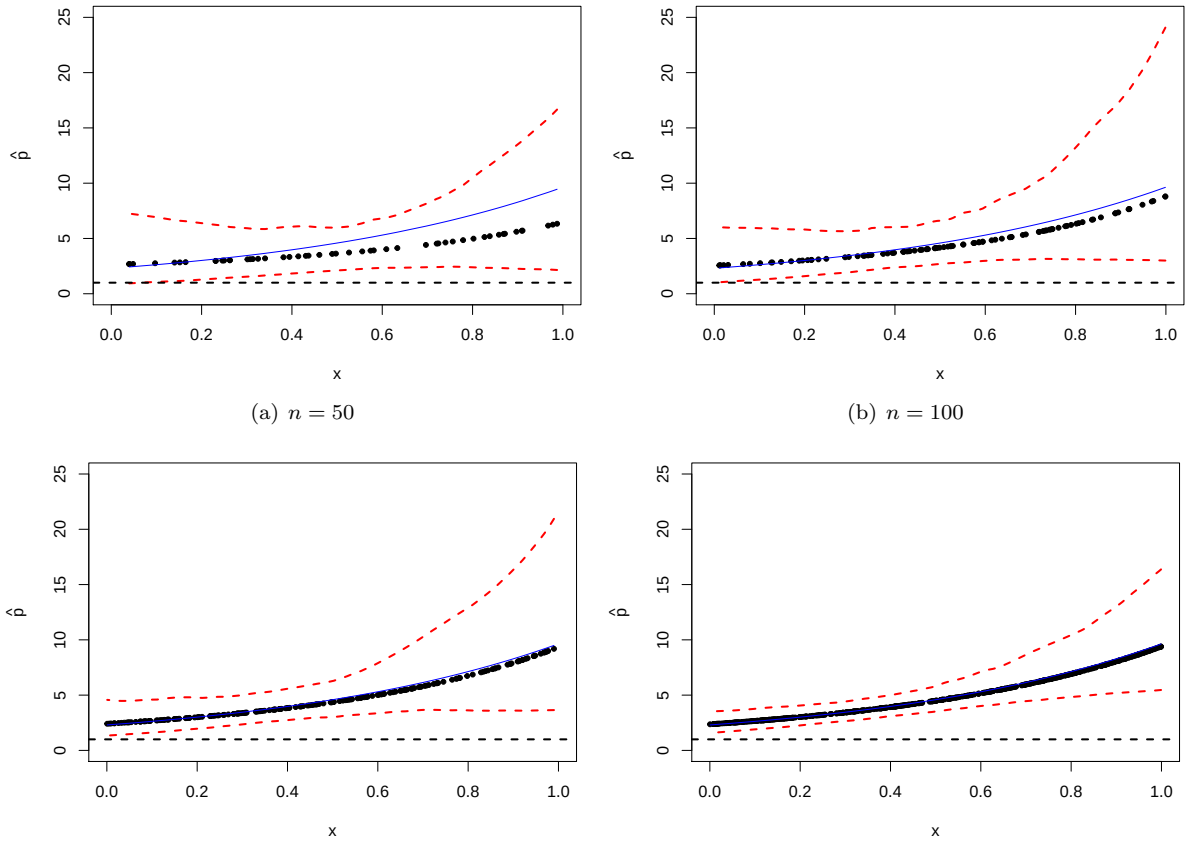


(c) $n = 200$



(d) $n = 500$

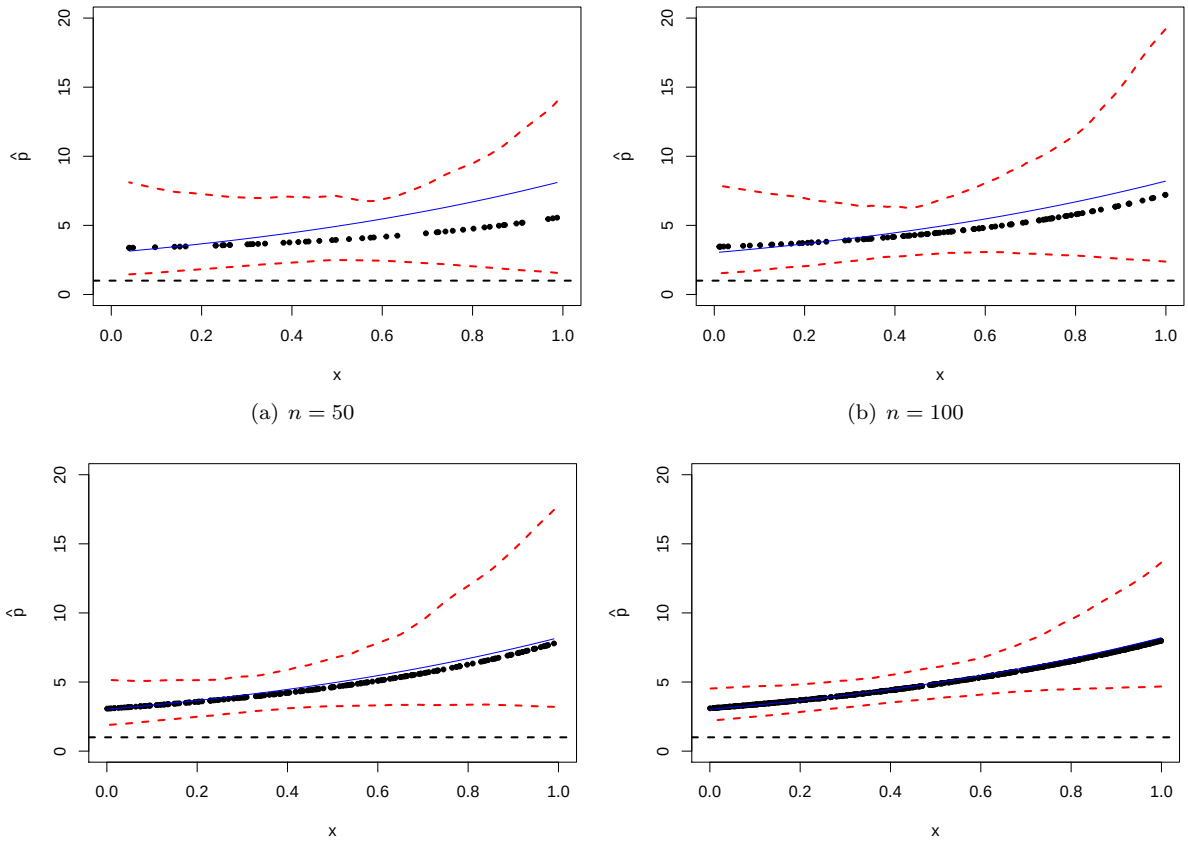
Figure 14: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 2).



(a) $n = 50$ (b) $n = 100$

(c) $n = 200$ (d) $n = 500$

Figure 15: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 3).



(a) $n = 50$ (b) $n = 100$

(c) $n = 200$ (d) $n = 500$

Figure 16: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 4).

2.2 Using *probit* link function

Table 25: Empirical properties of the Bayesian estimators using zero-deflated artificial samples (Scenarios 1 and 2).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 1		
50	β_{10}	0.081	0.324	1.010	45.581
	β_{11}	−0.164	0.839	1.016	74.955
	β_{20}	−0.001	0.156	1.000	62.082
	β_{21}	−0.050	0.471	1.003	109.956
100	β_{10}	0.053	0.197	1.007	35.633
	β_{11}	−0.075	0.485	1.006	55.800
	β_{20}	−0.034	0.092	1.006	47.660
	β_{21}	0.030	0.301	1.002	86.294
200	β_{10}	0.012	0.078	1.001	22.714
	β_{11}	−0.017	0.231	1.001	38.300
	β_{20}	−0.022	0.035	1.007	29.615
	β_{21}	0.020	0.123	1.002	55.809
500	β_{10}	0.016	0.040	1.003	15.990
	β_{11}	−0.028	0.098	1.004	25.124
	β_{20}	0.006	0.016	1.001	19.987
	β_{21}	−0.011	0.047	1.001	35.119
			Scenario 2		
50	β_{10}	0.050	0.266	1.005	41.381
	β_{11}	−0.084	0.744	1.005	67.351
	β_{20}	−0.072	0.205	1.013	24.018
	β_{21}	0.057	0.512	1.003	56.514
100	β_{10}	0.012	0.171	1.000	32.812
	β_{11}	−0.022	0.445	1.001	52.762
	β_{20}	−0.014	0.138	1.001	19.169
	β_{21}	0.002	0.380	1.000	48.545
200	β_{10}	0.010	0.072	1.001	21.244
	β_{11}	−0.020	0.214	1.001	37.192
	β_{20}	−0.031	0.043	1.012	11.013
	β_{21}	0.042	0.136	1.007	29.241
500	β_{10}	0.019	0.028	1.007	13.449
	β_{11}	−0.028	0.074	1.005	21.794
	β_{20}	0.002	0.026	1.000	8.697
	β_{21}	−0.004	0.061	1.000	19.548

Table 26: Empirical properties of the Bayesian estimators using zero-deflated artificial samples (Scenarios 3 and 4).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 3		
50	β_{10}	0.018	0.371	1.000	47.775
	β_{11}	0.463	1.251	1.099	58.669
	β_{20}	−0.019	0.146	1.001	60.599
	β_{21}	−0.040	0.446	1.002	104.663
100	β_{10}	−0.003	0.287	1.000	43.011
	β_{11}	0.253	0.969	1.035	51.804
	β_{20}	−0.020	0.079	1.002	44.592
	β_{21}	0.017	0.253	1.001	79.059
200	β_{10}	−0.028	0.125	1.003	27.594
	β_{11}	0.159	0.539	1.024	38.997
	β_{20}	−0.003	0.035	1.000	29.779
	β_{21}	0.006	0.136	1.000	56.819
500	β_{10}	−0.005	0.058	1.000	19.370
	β_{11}	0.054	0.223	1.007	25.061
	β_{20}	−0.002	0.014	1.000	19.111
	β_{21}	−0.006	0.046	1.000	34.241
			Scenario 4		
50	β_{10}	−0.076	0.372	1.008	48.160
	β_{11}	0.624	1.415	1.174	62.839
	β_{20}	−0.069	0.215	1.011	25.209
	β_{21}	0.034	0.546	1.001	58.479
100	β_{10}	−0.051	0.231	1.006	38.240
	β_{11}	0.352	0.930	1.074	51.961
	β_{20}	0.013	0.119	1.001	17.847
	β_{21}	−0.050	0.320	1.004	44.541
200	β_{10}	0.005	0.111	1.000	25.939
	β_{11}	0.133	0.544	1.017	39.311
	β_{20}	−0.010	0.059	1.001	12.777
	β_{21}	0.001	0.163	1.000	32.126
500	β_{10}	−0.001	0.045	1.000	17.131
	β_{11}	0.079	0.185	1.017	23.264
	β_{20}	−0.011	0.022	1.003	8.025
	β_{21}	0.014	0.054	1.002	18.553

Table 27: *Posterior* estimates for model parameters using zero-deflated artificial samples (Scenarios 1 and 2).

n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
			Scenario 1			
50	β_{10}	−0.919	−0.906	0.563	−2.094	0.239
	β_{11}	0.836	0.832	0.901	−0.993	2.668
	β_{20}	0.499	0.495	0.394	−0.267	1.276
	β_{21}	0.450	0.446	0.684	−0.905	1.811
100	β_{10}	−0.947	−0.940	0.440	−1.850	−0.054
	β_{11}	0.925	0.922	0.693	−0.500	2.357
	β_{20}	0.466	0.464	0.302	−0.114	1.047
	β_{21}	0.530	0.528	0.548	−0.501	1.560
200	β_{10}	−0.988	−0.985	0.280	−1.567	−0.412
	β_{11}	0.983	0.982	0.480	0.025	1.945
	β_{20}	0.478	0.477	0.186	0.114	0.844
	β_{21}	0.520	0.518	0.350	−0.176	1.214
500	β_{10}	−0.984	−0.983	0.199	−1.362	−0.608
	β_{11}	0.972	0.972	0.311	0.385	1.560
	β_{20}	0.506	0.506	0.125	0.269	0.744
	β_{21}	0.489	0.489	0.217	0.068	0.909
			Scenario 2			
50	β_{10}	−0.950	−0.938	0.514	−2.034	0.121
	β_{11}	0.916	0.914	0.858	−0.855	2.694
	β_{20}	1.428	1.410	0.447	0.496	2.388
	β_{21}	−0.943	−0.931	0.713	−2.445	0.534
100	β_{10}	−0.988	−0.981	0.413	−1.826	−0.160
	β_{11}	0.978	0.976	0.667	−0.406	2.370
	β_{20}	1.486	1.477	0.371	0.771	2.218
	β_{21}	−0.998	−0.991	0.616	−2.162	0.154
200	β_{10}	−0.990	−0.987	0.268	−1.521	−0.462
	β_{11}	0.980	0.981	0.463	0.048	1.915
	β_{20}	1.469	1.465	0.205	1.017	1.924
	β_{21}	−0.958	−0.956	0.366	−1.726	−0.194
500	β_{10}	−0.981	−0.980	0.167	−1.327	−0.636
	β_{11}	0.972	0.972	0.270	0.403	1.540
	β_{20}	1.502	1.500	0.163	1.204	1.803
	β_{21}	−1.004	−1.003	0.246	−1.475	−0.536

Table 28: *Posterior* estimates for model parameters using zero-deflated artificial samples (Scenarios 3 and 4).

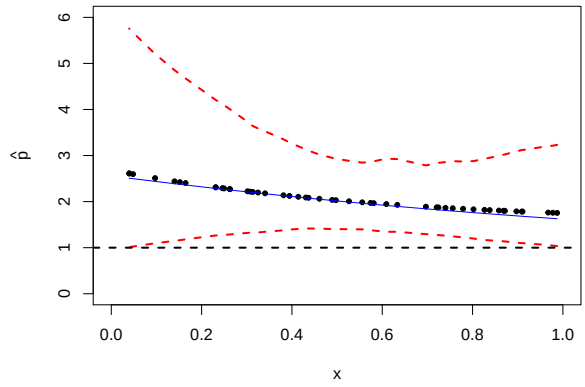
n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
Scenario 3						
50	β_{10}	−0.982	−0.960	0.609	−2.438	0.431
	β_{11}	−1.037	−1.023	1.018	−3.661	1.571
	β_{20}	0.481	0.477	0.381	−0.284	1.248
	β_{21}	0.460	0.456	0.666	−0.883	1.816
100	β_{10}	−1.003	−0.989	0.536	−2.138	0.113
	β_{11}	−1.247	−1.240	0.951	−3.347	0.841
	β_{20}	0.480	0.479	0.281	−0.100	1.063
	β_{21}	0.517	0.515	0.503	−0.514	1.551
200	β_{10}	−1.028	−1.022	0.352	−1.750	−0.312
	β_{11}	−1.341	−1.332	0.717	−2.829	0.126
	β_{20}	0.497	0.496	0.187	0.133	0.863
	β_{21}	0.506	0.504	0.368	−0.188	1.203
500	β_{10}	−1.005	−1.002	0.240	−1.475	−0.536
	β_{11}	−1.446	−1.443	0.470	−2.354	−0.540
	β_{20}	0.498	0.498	0.120	0.261	0.736
	β_{21}	0.494	0.494	0.214	0.074	0.913
Scenario 4						
50	β_{10}	−1.076	−1.056	0.605	−2.432	0.241
	β_{11}	−0.876	−0.862	1.013	−3.440	1.667
	β_{20}	1.431	1.414	0.459	0.503	2.389
	β_{21}	−0.966	−0.956	0.738	−2.459	0.509
100	β_{10}	−1.051	−1.039	0.478	−2.089	−0.028
	β_{11}	−1.147	−1.140	0.898	−3.168	0.856
	β_{20}	1.513	1.503	0.345	0.795	2.250
	β_{21}	−1.050	−1.043	0.563	−2.218	0.105
200	β_{10}	−0.995	−0.990	0.332	−1.645	−0.353
	β_{11}	−1.367	−1.356	0.725	−2.797	0.049
	β_{20}	1.490	1.486	0.242	1.034	1.952
	β_{21}	−0.999	−0.997	0.404	−1.771	−0.233
500	β_{10}	−1.001	−0.999	0.212	−1.425	−0.581
	β_{11}	−1.421	−1.418	0.423	−2.297	−0.552
	β_{20}	1.489	1.487	0.150	1.192	1.789
	β_{21}	−0.986	−0.984	0.233	−1.456	−0.518

Table 29: Coverage probabilities (%) of the HPDIs using zero-deflated artificial samples (Scenarios 1 and 2).

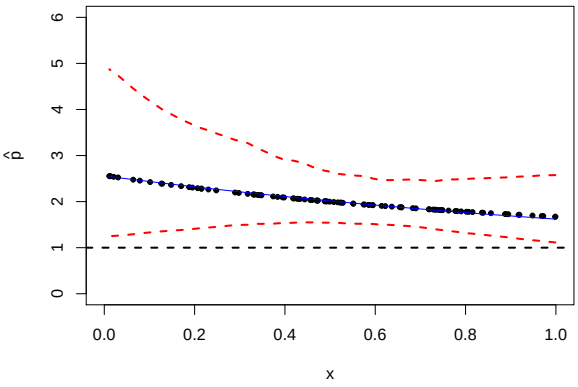
n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 1			Scenario 2		
50	β_{10}	4.60	94.80	0.60	3.40	96.20	0.40
	β_{11}	0.80	96.80	2.40	1.60	95.80	2.60
	β_{20}	1.60	95.80	2.60	0.00	97.00	3.00
	β_{21}	1.40	96.00	2.60	1.60	97.80	0.60
100	β_{10}	3.60	95.20	1.20	2.60	96.40	1.00
	β_{11}	0.80	96.00	3.20	1.60	96.60	1.80
	β_{20}	1.60	95.40	3.00	1.60	94.20	4.20
	β_{21}	2.80	94.40	2.80	3.40	94.60	2.00
200	β_{10}	2.60	96.20	1.20	2.80	95.40	1.80
	β_{11}	2.20	96.00	1.80	1.60	96.20	2.20
	β_{20}	1.80	94.80	3.40	0.80	95.60	3.60
	β_{21}	1.80	95.40	2.80	3.40	95.40	1.20
500	β_{10}	4.60	93.60	1.80	4.00	94.80	1.20
	β_{11}	2.00	94.40	3.60	1.00	96.60	2.40
	β_{20}	1.80	95.40	2.80	3.00	94.00	3.00
	β_{21}	3.20	94.60	2.20	2.60	94.20	3.20

Table 30: Coverage probabilities (%) of the HPDIs using zero-deflated artificial samples (Scenarios 3 and 4).

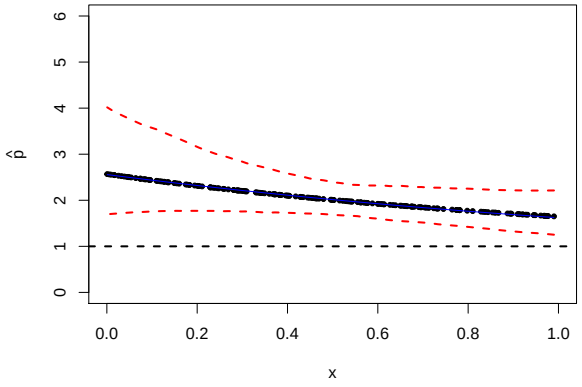
n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 3			Scenario 4		
50	β_{10}	1.80	98.00	0.20	1.00	98.00	1.00
	β_{11}	1.80	98.00	0.20	3.80	96.20	0.00
	β_{20}	1.40	95.60	3.00	0.40	96.00	3.60
	β_{21}	1.40	96.00	2.60	3.20	95.60	1.20
100	β_{10}	1.40	98.20	0.40	2.00	97.20	0.80
	β_{11}	2.60	97.00	0.40	2.20	97.20	0.60
	β_{20}	1.80	96.40	1.80	0.60	97.00	2.40
	β_{21}	2.00	95.60	2.40	1.40	96.80	1.80
200	β_{10}	2.60	95.80	1.60	4.00	93.40	2.60
	β_{11}	3.20	96.20	0.60	5.60	93.40	1.00
	β_{20}	2.40	95.40	2.20	2.00	94.60	3.40
	β_{21}	2.40	94.40	3.20	2.60	94.60	2.80
500	β_{10}	2.20	95.60	2.20	3.20	95.60	1.20
	β_{11}	4.00	94.00	2.00	2.40	96.80	0.80
	β_{20}	3.60	94.80	1.60	1.40	94.40	4.20
	β_{21}	2.40	94.40	3.20	2.40	95.60	2.00



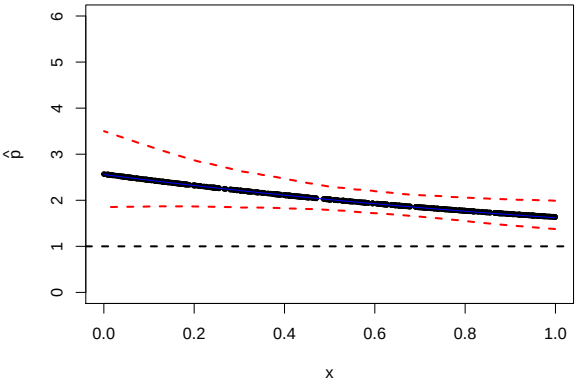
(a) $n = 50$



(b) $n = 100$

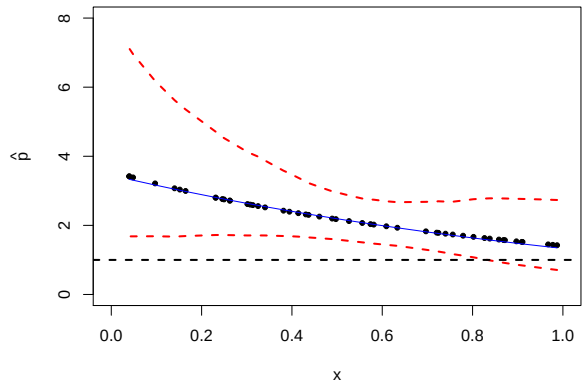


(c) $n = 200$

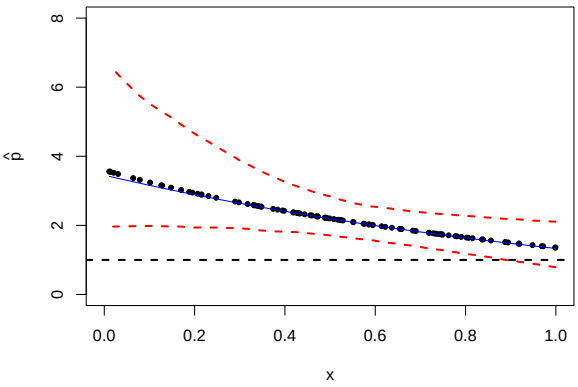


(d) $n = 500$

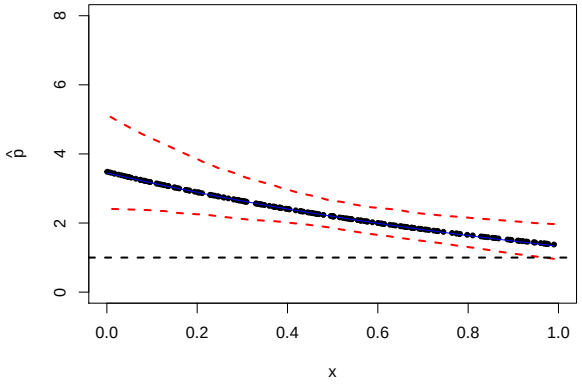
Figure 17: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 1).



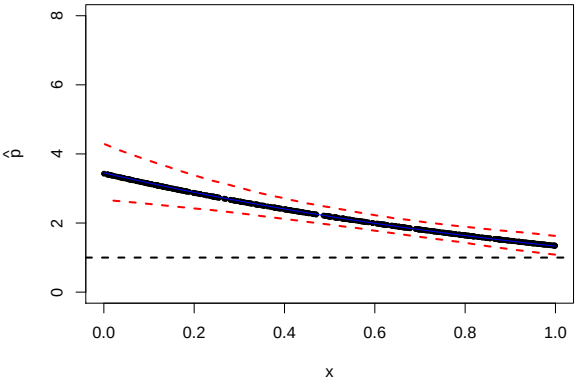
(a) $n = 50$



(b) $n = 100$

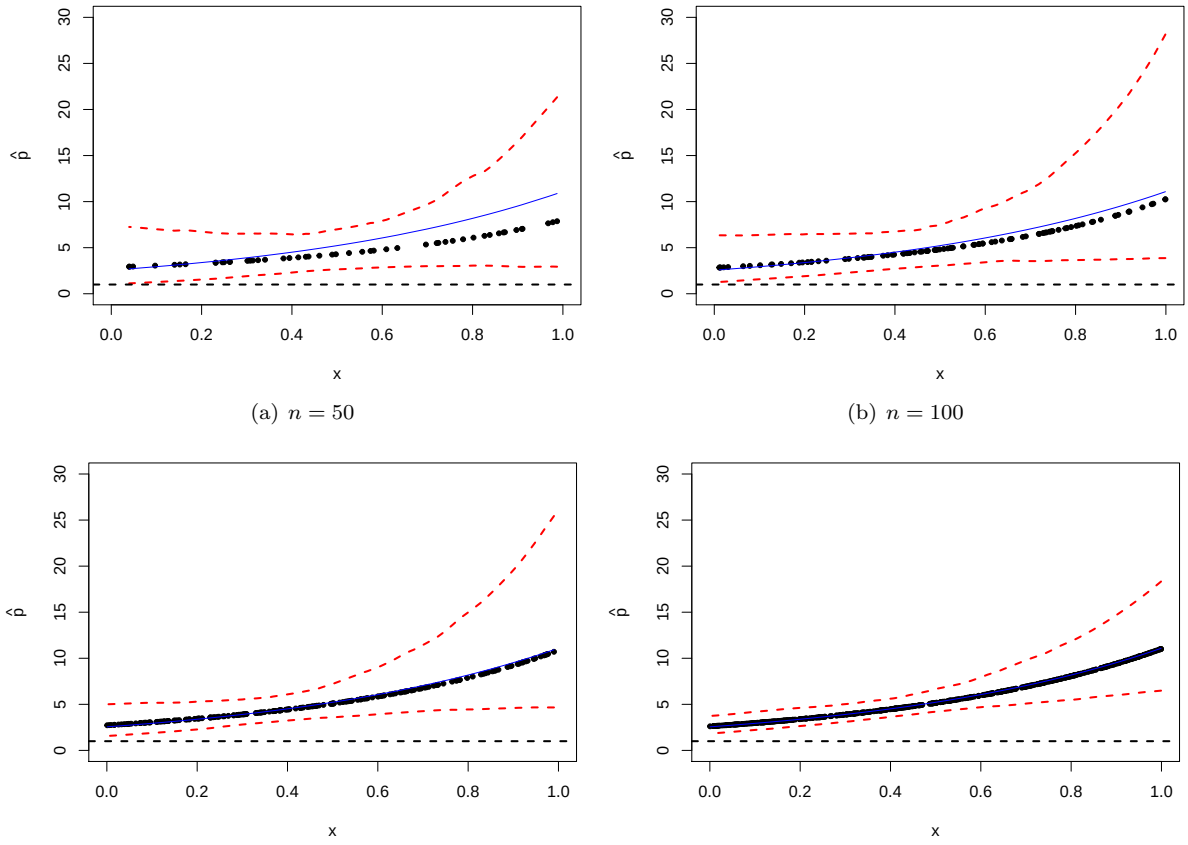


(c) $n = 200$



(d) $n = 500$

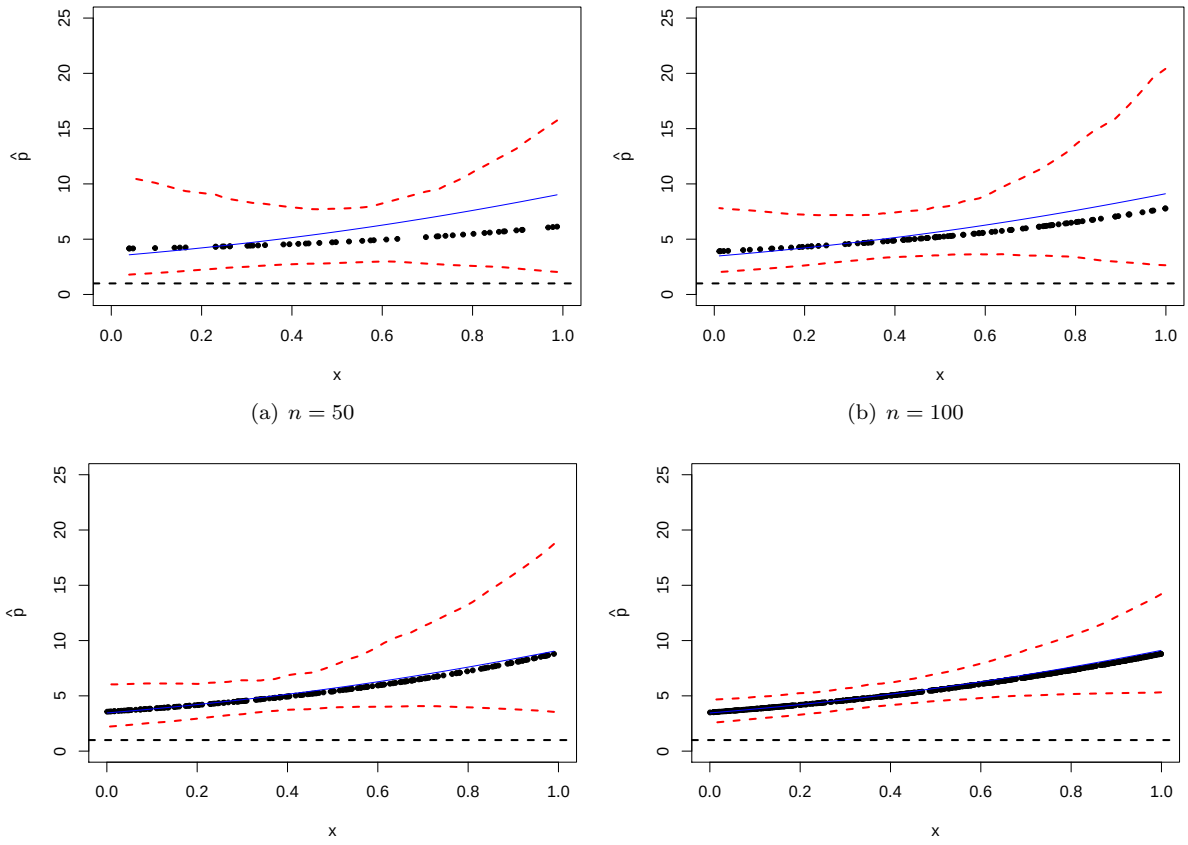
Figure 18: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 2).



(a) $n = 50$ (b) $n = 100$

(c) $n = 200$ (d) $n = 500$

Figure 19: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 3).



(a) $n = 50$ (b) $n = 100$

(c) $n = 200$ (d) $n = 500$

Figure 20: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 4).

2.3 Using *complementary log-log* link function

Table 31: Empirical properties of the Bayesian estimators using zero-deflated artificial samples (Scenarios 1 and 2).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 1		
50	β_{10}	0.029	0.293	1.001	43.753
	β_{11}	−0.053	0.701	1.002	66.609
	β_{20}	0.003	0.145	1.000	58.741
	β_{21}	0.026	0.453	1.001	104.497
100	β_{10}	0.038	0.173	1.004	33.532
	β_{11}	−0.076	0.442	1.007	52.590
	β_{20}	0.008	0.084	1.000	45.671
	β_{21}	−0.018	0.265	1.001	81.344
200	β_{10}	−0.008	0.083	1.000	23.138
	β_{11}	−0.005	0.227	1.000	38.595
	β_{20}	−0.015	0.037	1.003	30.755
	β_{21}	0.024	0.128	1.002	57.261
500	β_{10}	0.016	0.030	1.004	14.056
	β_{11}	−0.024	0.073	1.004	21.857
	β_{20}	0.000	0.013	1.000	18.317
	β_{21}	0.001	0.038	1.000	31.269
			Scenario 2		
50	β_{10}	0.051	0.227	1.006	37.842
	β_{11}	−0.087	0.653	1.006	63.138
	β_{20}	0.018	0.241	1.001	26.949
	β_{21}	−0.021	0.604	1.000	62.615
100	β_{10}	0.046	0.148	1.007	30.337
	β_{11}	−0.075	0.421	1.007	51.438
	β_{20}	−0.003	0.141	1.000	19.373
	β_{21}	−0.005	0.344	1.000	45.974
200	β_{10}	0.013	0.065	1.001	20.105
	β_{11}	−0.028	0.188	1.002	34.055
	β_{20}	0.012	0.051	1.001	11.641
	β_{21}	−0.010	0.131	1.000	28.292
500	β_{10}	0.008	0.028	1.001	13.446
	β_{11}	−0.013	0.072	1.001	21.606
	β_{20}	0.003	0.026	1.000	8.472
	β_{21}	−0.012	0.059	1.001	19.093

Table 32: Empirical properties of the Bayesian estimators using zero-deflated artificial samples (Scenarios 3 and 4).

n	Parameter	Bias	MSE	$\sqrt{\frac{\text{MSE}}{\text{Var}}}$	MAPE (%)
			Scenario 3		
50	β_{10}	0.046	0.333	1.003	45.611
	β_{11}	0.370	1.070	1.071	55.202
	β_{20}	−0.008	0.149	1.000	59.638
	β_{21}	0.000	0.478	1.000	105.774
100	β_{10}	−0.013	0.246	1.000	39.508
	β_{11}	0.294	0.834	1.056	48.762
	β_{20}	−0.005	0.082	1.000	44.686
	β_{21}	−0.009	0.230	1.000	75.884
200	β_{10}	0.007	0.100	1.000	25.257
	β_{11}	0.129	0.482	1.018	36.353
	β_{20}	−0.006	0.029	1.001	26.834
	β_{21}	−0.004	0.111	1.000	53.146
500	β_{10}	−0.002	0.051	1.000	18.389
	β_{11}	0.048	0.179	1.006	22.600
	β_{20}	0.003	0.014	1.000	19.103
	β_{21}	−0.009	0.045	1.001	34.072
			Scenario 4		
50	β_{10}	−0.038	0.322	1.002	45.114
	β_{11}	0.564	1.249	1.159	58.836
	β_{20}	−0.024	0.225	1.001	25.803
	β_{21}	−0.003	0.524	1.000	58.195
100	β_{10}	0.013	0.228	1.000	38.213
	β_{11}	0.188	0.898	1.020	49.778
	β_{20}	0.010	0.140	1.000	19.337
	β_{21}	−0.042	0.334	1.003	45.964
200	β_{10}	−0.015	0.088	1.001	23.347
	β_{11}	0.163	0.449	1.031	35.552
	β_{20}	−0.008	0.064	1.000	13.124
	β_{21}	0.021	0.169	1.001	32.044
500	β_{10}	0.007	0.041	1.000	16.224
	β_{11}	0.031	0.170	1.003	21.934
	β_{20}	0.011	0.027	1.002	8.345
	β_{21}	−0.013	0.058	1.002	18.718

Table 33: *Posterior* estimates for model parameters using zero-deflated artificial samples (Scenarios 1 and 2).

n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
Scenario 1						
50	β_{10}	−0.971	−0.960	0.540	−2.078	0.113
	β_{11}	0.947	0.943	0.836	−0.760	2.667
	β_{20}	0.503	0.506	0.381	−0.256	1.256
	β_{21}	0.526	0.513	0.672	−0.831	1.907
100	β_{10}	−0.962	−0.956	0.414	−1.805	−0.126
	β_{11}	0.924	0.922	0.661	−0.418	2.270
	β_{20}	0.508	0.511	0.290	−0.051	1.062
	β_{21}	0.482	0.478	0.514	−0.499	1.474
200	β_{10}	−1.008	−1.006	0.287	−1.550	−0.470
	β_{11}	0.995	0.995	0.476	0.095	1.897
	β_{20}	0.485	0.486	0.191	0.139	0.829
	β_{21}	0.524	0.522	0.358	−0.132	1.181
500	β_{10}	−0.984	−0.983	0.174	−1.338	−0.633
	β_{11}	0.976	0.975	0.270	0.424	1.528
	β_{20}	0.500	0.500	0.113	0.277	0.722
	β_{21}	0.501	0.500	0.194	0.110	0.892
Scenario 2						
50	β_{10}	−0.949	−0.939	0.474	−1.991	0.077
	β_{11}	0.913	0.911	0.803	−0.768	2.600
	β_{20}	1.518	1.477	0.491	0.488	2.633
	β_{21}	−1.021	−0.984	0.777	−2.690	0.579
100	β_{10}	−0.954	−0.948	0.382	−1.750	−0.168
	β_{11}	0.925	0.924	0.644	−0.384	2.233
	β_{20}	1.497	1.480	0.376	0.756	2.270
	β_{21}	−1.005	−0.986	0.586	−2.210	0.168
200	β_{10}	−0.987	−0.985	0.254	−1.496	−0.484
	β_{11}	0.972	0.972	0.432	0.090	1.855
	β_{20}	1.512	1.505	0.226	1.046	1.991
	β_{21}	−1.010	−1.002	0.362	−1.792	−0.242
500	β_{10}	−0.992	−0.991	0.169	−1.325	−0.661
	β_{11}	0.987	0.987	0.268	0.447	1.525
	β_{20}	1.503	1.500	0.162	1.206	1.804
	β_{21}	−1.012	−1.009	0.243	−1.478	−0.552

Table 34: *Posterior* estimates for model parameters using zero-deflated artificial samples (Scenarios 3 and 4).

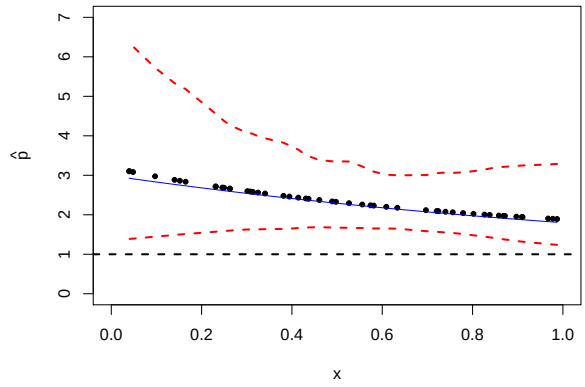
n	Parameter	Mean	Median	Std. Dev.	95% HPDI	
					Lower	Upper
Scenario 3						
50	β_{10}	−0.954	−0.935	0.576	−2.304	0.363
	β_{11}	−1.131	−1.117	0.966	−3.610	1.332
	β_{20}	0.492	0.496	0.386	−0.264	1.243
	β_{21}	0.500	0.489	0.691	−0.845	1.866
100	β_{10}	−1.013	−1.001	0.496	−2.073	0.029
	β_{11}	−1.206	−1.200	0.864	−3.170	0.750
	β_{20}	0.495	0.498	0.286	−0.063	1.047
	β_{21}	0.491	0.488	0.479	−0.488	1.476
200	β_{10}	−0.993	−0.988	0.316	−1.664	−0.333
	β_{11}	−1.371	−1.363	0.682	−2.756	0.002
	β_{20}	0.494	0.495	0.169	0.149	0.836
	β_{21}	0.496	0.494	0.333	−0.155	1.150
500	β_{10}	−1.002	−1.000	0.226	−1.440	−0.568
	β_{11}	−1.452	−1.450	0.421	−2.304	−0.602
	β_{20}	0.503	0.504	0.120	0.280	0.725
	β_{21}	0.491	0.491	0.212	0.101	0.881
Scenario 4						
50	β_{10}	−1.038	−1.020	0.566	−2.329	0.224
	β_{11}	−0.936	−0.921	0.964	−3.372	1.476
	β_{20}	1.476	1.440	0.474	0.477	2.552
	β_{21}	−1.003	−0.967	0.724	−2.620	0.549
100	β_{10}	−0.987	−0.977	0.477	−1.984	−0.011
	β_{11}	−1.312	−1.303	0.929	−3.247	0.616
	β_{20}	1.510	1.493	0.375	0.766	2.287
	β_{21}	−1.042	−1.021	0.576	−2.251	0.134
200	β_{10}	−1.015	−1.011	0.296	−1.643	−0.394
	β_{11}	−1.337	−1.328	0.650	−2.696	0.008
	β_{20}	1.492	1.485	0.253	1.028	1.967
	β_{21}	−0.979	−0.971	0.410	−1.757	−0.211
500	β_{10}	−0.993	−0.992	0.203	−1.403	−0.589
	β_{11}	−1.469	−1.466	0.411	−2.304	−0.635
	β_{20}	1.511	1.508	0.163	1.212	1.813
	β_{21}	−1.013	−1.010	0.241	−1.479	−0.551

Table 35: Coverage probabilities (%) of the HPDIs using zero-deflated artificial samples (Scenarios 1 and 2).

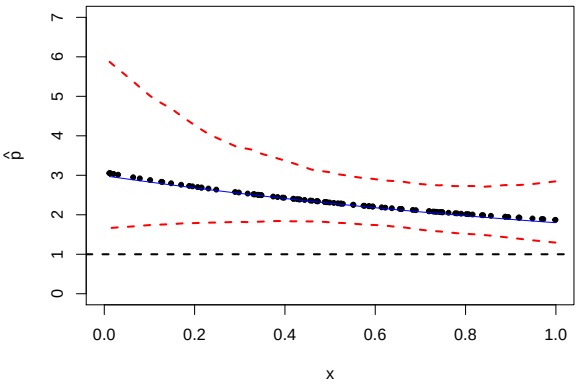
n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 1			Scenario 2		
50	β_{10}	3.40	95.80	0.80	3.40	95.80	0.80
	β_{11}	1.20	96.60	2.20	1.00	96.00	3.00
	β_{20}	1.60	96.80	1.60	0.00	97.40	2.60
	β_{21}	0.80	97.40	1.80	2.00	98.00	0.00
100	β_{10}	3.20	96.20	0.60	3.80	94.60	1.60
	β_{11}	1.20	95.80	3.00	1.80	95.80	2.40
	β_{20}	2.00	96.80	1.20	0.40	96.80	2.80
	β_{21}	2.40	96.00	1.60	2.40	96.80	0.80
200	β_{10}	3.00	93.80	3.20	2.60	95.20	2.20
	β_{11}	2.20	95.00	2.80	2.00	96.00	2.00
	β_{20}	3.20	93.80	3.00	0.60	96.80	2.60
	β_{21}	3.40	94.40	2.20	2.20	97.40	0.40
500	β_{10}	2.20	96.60	1.20	3.40	94.40	2.20
	β_{11}	0.80	96.40	2.80	1.80	94.40	3.80
	β_{20}	2.20	96.00	1.80	2.40	92.80	4.80
	β_{21}	2.20	95.40	2.40	3.00	94.60	2.40

Table 36: Coverage probabilities (%) of the HPDIs using zero-deflated artificial samples (Scenarios 3 and 4).

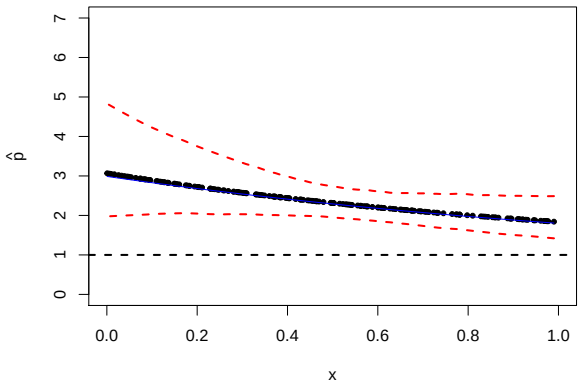
n	Parameter	BNCP	CP	ANCP	BNCP	CP	ANCP
		Scenario 3			Scenario 4		
50	β_{10}	3.20	96.80	0.00	2.20	97.80	0.00
	β_{11}	1.00	98.60	0.40	3.80	96.20	0.00
	β_{20}	1.00	97.40	1.60	0.00	96.40	3.60
	β_{21}	0.80	97.00	2.20	1.80	98.00	0.20
100	β_{10}	2.60	96.60	0.80	3.00	96.20	0.80
	β_{11}	2.80	96.80	0.40	4.00	95.40	0.60
	β_{20}	2.00	95.80	2.20	0.20	96.80	3.00
	β_{21}	1.60	96.40	2.00	1.40	98.20	0.40
200	β_{10}	2.20	96.80	1.00	2.40	96.20	1.40
	β_{11}	3.40	95.40	1.20	3.80	95.60	0.60
	β_{20}	1.80	95.60	2.60	1.20	94.40	4.40
	β_{21}	2.80	95.00	2.20	4.20	94.00	1.80
500	β_{10}	1.60	96.20	2.20	3.00	95.20	1.80
	β_{11}	3.00	96.00	1.00	3.00	96.00	1.00
	β_{20}	2.40	94.00	3.60	2.80	94.80	2.40
	β_{21}	2.20	95.00	2.80	2.00	95.60	2.40



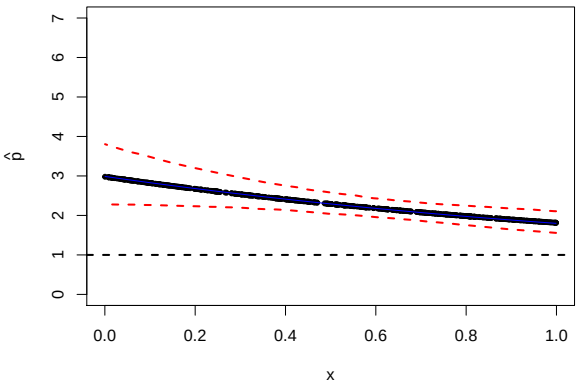
(a) $n = 50$



(b) $n = 100$

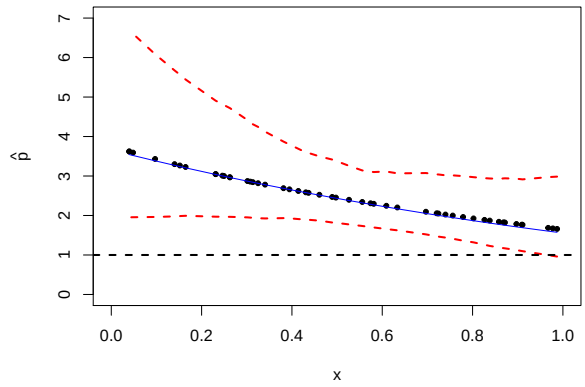


(c) $n = 200$

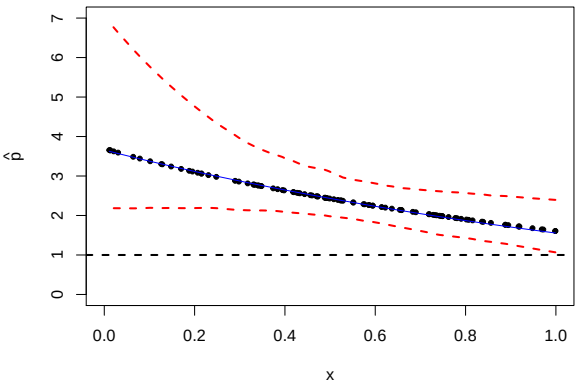


(d) $n = 500$

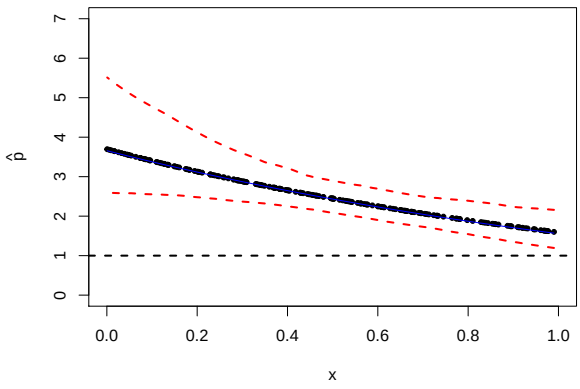
Figure 21: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 1).



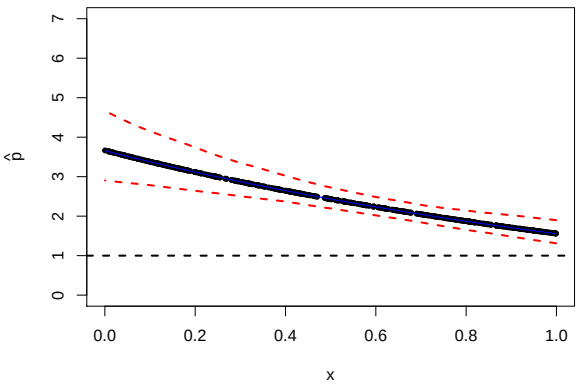
(a) $n = 50$



(b) $n = 100$

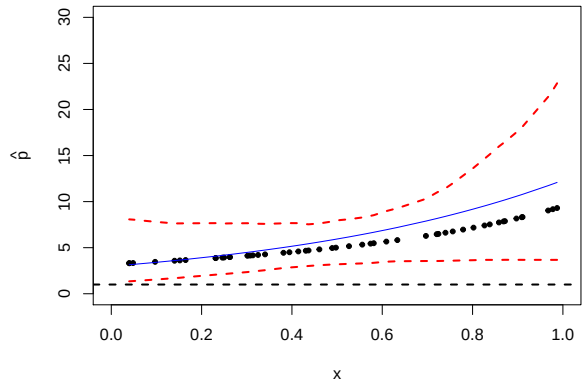


(c) $n = 200$

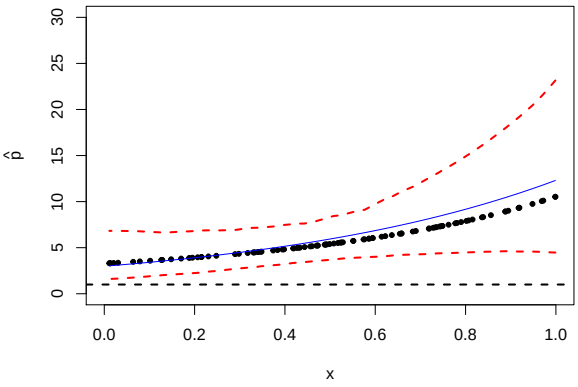


(d) $n = 500$

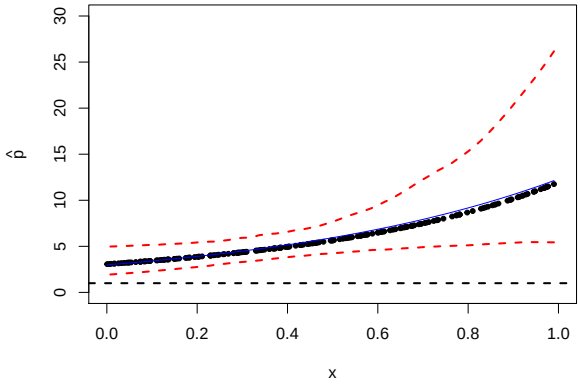
Figure 22: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 2).



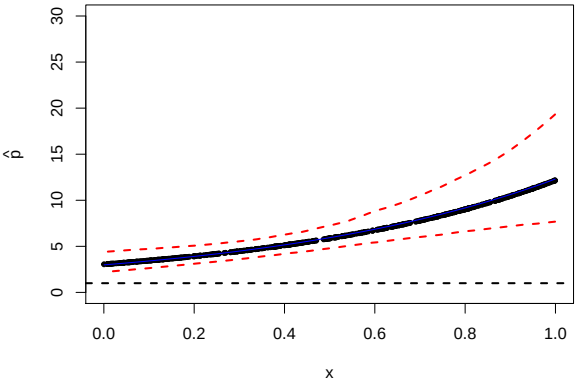
(a) $n = 50$



(b) $n = 100$

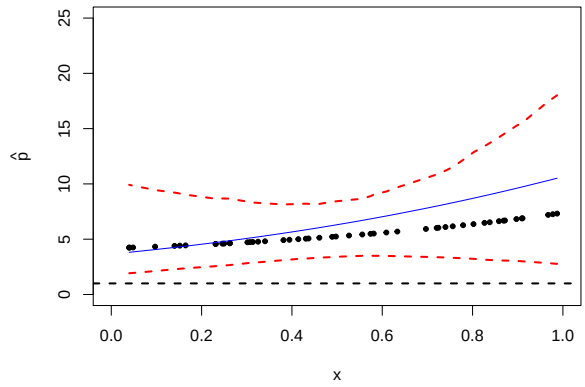


(c) $n = 200$

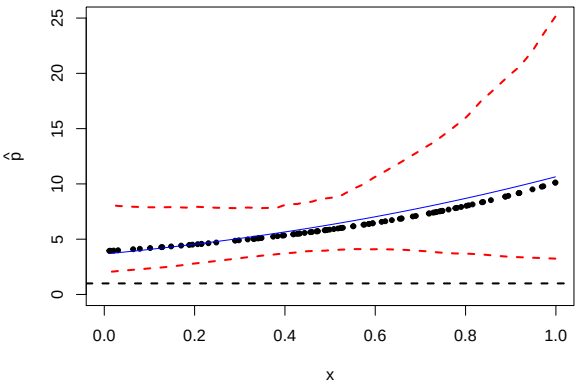


(d) $n = 500$

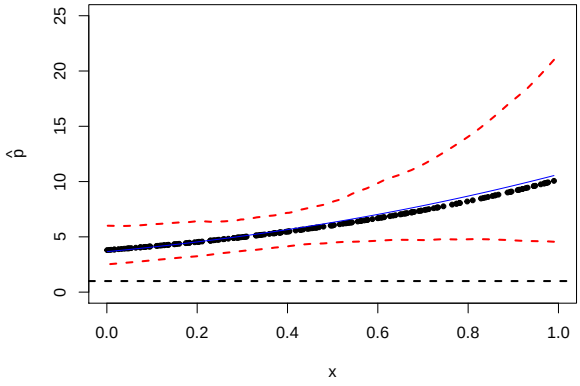
Figure 23: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 3).



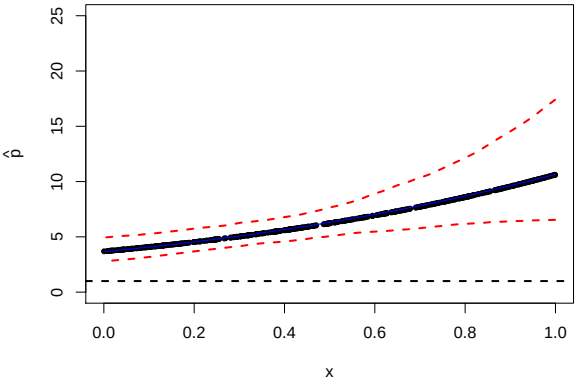
(a) $n = 50$



(b) $n = 100$



(c) $n = 200$



(d) $n = 500$

Figure 24: *Posterior* estimates for parameter p using zero-deflated artificial samples (Scenario 4).