Hydrol. Earth Syst. Sci. Discuss., 7, C1961–C1970, 2010
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Hydrology and Earth System Sciences Discussions

Interactive comment on "On accuracy of upper quantiles estimation" *by* I. Markiewicz et al.

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Received and published: 24 August 2010

The authors greatly appreciate the thoughtful comments of the Anonymous Referee #1. The paper has been revised following these comments. Specifically, here is what has been done to response to each comment and the subsequent revision made in the paper.

1. Page 4762, lines 24-26.

The Referee is right. Therefore we put in the line 19 after "Flood frequency analysis" its acronym (FFA) and in the line 24 "FFA" instead of "Flood Forecasting".

2. Page 4765 line 17.

We replaced "accounting difficulties" by "computational difficulties".

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3. Page 4766 line 7.

The proposal of rephrasing accepted.

4. Tables 3-10.

The proposal of underlining the best values on each row is implemented and the respective note is added on the page 4767, line 11:

". . . distributions, respectively. In all tables, the best values of the relative RMSE and B on each row are bolded. In the asymptotic case . . ."

5. Page 4768, lines 24-27.

The Referee is right. Since the estimate of the mean is unbiased, in MOM, the bias of upper quantile comes from the bias of SD. We rephrase the lines 25-26: "large skewness as well this time), the bias of the MOM estimator of the standard deviation, and consequently of the 1% quantile, decreases very slowly with increasing sample size. This is. . .. . ."

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 4761, 2010.

Table 3. Relative accuracy [%] of $\hat{x}_{0.99}$ for sample from LN2, assuming LN2 model.

T=LN2, H=LN2		MOM		LMM		MDM		MLM	
$\mu > 0$	N	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB
$C_V = 0.2$ $x_{0.99} = 1.554\mu$	20	8.690	-1.574	8.875	**0.191**	8.960	-0.850	**8.634**	-1.416
	60	5.089	-0.531	5.049	**0.061**	5.172	-0.276	**4.985**	-0.451
	100	3.963	-0.327	**3.901**	**0.023**	4.014	-0.179	4.070	-0.322
$C_V = 0.6$ $x_{0.99} = 3.115\mu$	20	25.80	-5.500	26.51	1.189	26.15	**-1.130**	**23.98**	-2.087
	60	16.40	-2.087	14.97	0.387	15.06	**-0.355**	**13.85**	-0.674
	100	13.21	-1.271	11.56	**0.209**	11.69	-0.244	**10.70**	-0.450
$C_V = 1.0$ $x_{0..99} = 4.905\mu$	20	38.64	-11.41	43.30	2.097	42.53	**-0.661**	**37.17**	-0.999
	60	26.38	-5.319	24.33	0.723	24.24	**-0.131**	**21.01**	-0.306
	100	22.14	-3.524	18.82	0.443	18.79	**-0.087**	**16.16**	-0.245

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Table 4. Relative accuracy [%] of $\hat{x}_{0.99}$ for sample from LG, assuming LG model.

T=LG, H=LG		MOM		LMM		MDM		MLM	
$\mu > 0$	N	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB
$C_V = 0.2$ $x_{0.99} = 1.711\mu$	20	15.86	-3.409	15.30	**0.387**	15.35	-0.612	**12.67**	-1.403
	60	10.33	-1.371	8.693	**0.131**	8.785	-0.186	**7.158**	-0.468
	100	8.475	-0.848	6.733	**0.070**	6.816	-0.125	**5.545**	-0.292
$C_V = 0.6$ $x_{0.99} = 3.183\mu$	20	32.74	-14.19	40.78	1.196	41.37	**-0.071**	**30.04**	-0.817
	60	23.52	-8.713	23.69	0.489	24.05	**0.182**	**16.62**	-0.314
	100	20.40	-6.804	18.81	0.378	19.05	**0.201**	**12.72**	-0.220
$C_V = 1.0$ $x_{0.99} = 4.167\mu$	20	40.38	-22.27	52.30	**0.363**	52.47	-0.851	**39.70**	0.408
	60	28.37	-16.29	32.89	0.272	33.24	0.112	**21.34**	**0.072**
	100	24.66	-13.40	27.20	0.367	27.35	0.320	**16.24**	**0.000**

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Table 5. Relative accuracy [%] of $\hat{x}_{0.99}$ for sample from LN3, assuming LN3 model.

T=LN3, H=LN3		MOM		LMM		MDM		MLM	
$\mu = 0$, $\sigma = 1$	N	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB
$C_S = 2.0$ $x_{0.99} = 3.519$	20	**11.68**	-4.87	14.18	**1.29**	14.12	1.366	21.13	4.288
	60	**7.644**	-2.46	7.844	0.252	8.326	**0.132**	7.954	0.937
	100	6.313	-1.74	6.011	0.198	6.628	**0.144**	**5.847**	0.517
$C_S = 4.0$ $x_{0.99} = 3.905$	20	**13.40**	-6.05	16.64	0.653	14.37	**-0.54**	27.08	7.338
	60	9.530	-3.34	9.411	0.382	9.198	**0.045**	**9.194**	1.712
	100	7.851	-2.51	7.126	0.035	7.058	**0.024**	**6.604**	0.971

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Table 6. Relative accuracy [%] of $\hat{x}_{0.99}$ for sample from GEV, assuming GEV model.

T=GEV, H=GEV		MOM		LMM		MDM		MLM		Reliability of MLM
$\mu=0$, $\sigma=1$	N	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB	
$C_S=2.0$ $x_{0.99}=3.479$	20	**36.23**	**-12.05**	53.69	22.37	45.23	17.06	82.61	14.14	93.78%
	60	**25.02**	-7.640	27.91	7.510	30.06	11.08	32.71	**3.076**	95.83%
	100	**20.73**	-6.009	21.25	3.857	23.91	7.212	23.71	**1.725**	96.01%
$C_S=4.0$ $x_{0.99}=3.696$	20	47.68	-19.47	59.07	13.52	**43.33**	**11.86**	111.1	21.54	95.17%
	60	34.35	-12.12	34.31	**2.070**	**29.96**	8.114	38.85	4.491	98.19%
	100	28.68	-9.514	27.14	**0.319**	**24.37**	4.958	28.00	2.165	98.67%

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Table 7. Relative accuracy [%] of $\hat{x}_{0.99}$ for sample from LN2, assuming LG model.

T=LN2, H=LG		MOM		LMM		MDM		MLM	
$\mu > 0$	N	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB
$C_V^{(LN)} = 0.2$ $x_{0.99} = 1.554\mu$	20	**12.83**	**8.065**	20.67	16.59	19.30	14.84	40.44	33.91
	60	**11.10**	**9.399**	17.83	16.39	17.23	15.68	41.20	38.61
	100	**10.71**	**9.662**	17.21	16.34	16.77	15.82	41.46	39.83
	∞	**10.08**	**10.08**	16.31	16.31	16.09	16.09	42.09	42.09
$C_V^{(LN)} = 0.6$ $x_{0.99} = 3.115\mu$	20	**21.21**	**-3.006**	45.02	29.91	42.10	26.12	190.5	142.6
	60	**13.26**	**0.169**	35.24	29.45	33.77	27.70	174.9	156.4
	100	**10.68**	**0.924**	32.95	29.33	31.75	27.97	171.9	160.2
	∞	**2.194**	**2.194**	29.22	29.22	28.46	28.46	167.4	167.4
$C_V^{(LN)} = 1.0$ $x_{0.99} = 4.905\mu$	20	**32.26**	-21.69	49.25	23.13	46.96	**19.43**	490.3	312.7
	60	**23.73**	**-18.18**	35.06	23.67	33.54	21.72	385.9	324.8
	100	**21.19**	**-17.19**	31.22	23.76	29.84	22.12	366.5	329.0
	∞	**15.04**	**-15.04**	23.90	23.90	22.78	22.78	337. 9	337.9

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Table 8. Relative accuracy [%] of $\hat{x}_{0.99}$ for sample from LG, assuming LN2 model.

T=LG, H=LN2		MOM		LMM		MDM		MLM	
$\mu > 0$	N	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB
$C_V^{(LG)} = 0.2$ $x_{0.99} = 1.711\mu$	20	18.21	**-11.75**	**16.94**	-12.76	17.41	-13.31	17.73	-14.55
	60	**13.58**	**-10.13**	14.34	-12.88	14.45	-12.97	15.02	-13.74
	100	**12.20**	**-9.767**	13.80	-12.89	13.82	-12.90	14.44	-13.56
	∞	**9.157**	**-9.157**	12.97	-12.97	12.87	-12.87	13.30	-13.30
$C_V^{(LG)} = 0.6$ $x_{0.99} = 3.183\mu$	20	45.48	**-16.71**	40.40	-19.84	43.01	-20.19	**35.11**	-28.46
	60	35.28	**-10.63**	**28.26**	-20.84	28.79	-20.67	30.27	-27.93
	100	31.16	**-8.830**	**25.76**	-21.08	25.99	-20.82	29.25	-27.84
	∞	**2.147**	**-2.147**	21.55	-21.55	21.22	-21.22	27.70	-27.70
$C_V^{(LG)} = 1.0$ $x_{0.99} = 4.167\mu$	20	61.95	**-17.71**	63.39	-19.47	56.80	-20.20	**42.12**	-33.77
	60	50.09	**-8.599**	40.71	-21.20	38.16	-20.72	**36.42**	-33.72
	100	45.57	**-5.411**	35.97	-21.65	**31.77**	-21.24	35.34	-33.72
	∞	**17.70**	**17.70**	22.65	-22.65	22.15	-22.15	33.70	-33.70

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Table 9. Relative accuracy [%] of $\hat{x}_{0.99}$ for sample from LN3, assuming GEV model.

T=LN3, H=GEV		MOM		LMM		MDM		MLM		Reliability of MLM
$\mu = 1$	N	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB	
$C_S^{(LN3)} = 2.0$ $x_{0.99} = 3.519$	20	**36.31**	-12.45	53.79	21.57	45.39	16.15	45.11	**10.13**	88.03%
	60	24.89	-8.018	28.71	7.946	31.38	12.56	**23.34**	**7.663**	96.41%
	100	20.61	-6.086	22.40	**5.369**	26.10	10.13	**17.30**	6.638	96.94%
$C_S^{(LN3)} = 4.0$ $x_{0.99} = 3.905$	20	51.18	-22.86	57.41	**7.624**	**40.11**	-10.80	*	*	77.93%
	60	35.11	-15.09	35.06	**3.333**	**28.22**	-3.860	65.60	35.76	92.99%
	100	28.67	-12.36	27.29	3.257	**23.75**	**-0.470**	55.85	35.48	92.18%

* Values are unreliable due to a low percentage of successful estimation

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Table 10. Relative accuracy [%] of $\hat{x}_{0.99}$ for sample from GEV, assuming LN3 model.

T=GEV, H= LN3		MOM		LMM		MDM		MLM	
$\mu = 1$	N	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB	$\delta RMSE$	δB
$C_S^{(GEV)} = 2.0$ $x_{0.99} = 3.479$	20	**41.29**	-17.54	48.99	1.887	48.17	**1.643**	66.80	6.154
	60	28.10	-8.912	27.49	**-2.329**	28.91	-3.493	**25.53**	-4.279
	100	23.04	-6.317	21.25	**-2.673**	22.67	-4.055	**19.44**	-5.439
$C_S^{(GEV)} = 4.0$ $x_{0.99} = 3.696$	20	**51.45**	-21.70	61.93	**-0.290**	55.06	-4.047	75.95	5.476
	60	36.79	-11.01	34.95	**-3.349**	33.48	-6.472	**28.89**	-8.278
	100	30.70	-7.657	27.03	**-3.733**	26.30	-6.715	**22.69**	-10.01

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