

1 **Supplementary Table S1.** Primiparae from individual age-season groups during the investigated  
 2 lactation periods

Year <sup>1</sup>	Year U <sup>2</sup>	Age	Season 1	Season 2	Season 3	Season 4	Σ
2009	2009-2010	Younger	12	16	17	17	62
		Older	10	18	18	16	62
2010	2010-2011	Younger	17	12	15	15	59
		Older	16	15	13	12	56
2011	2011-2012	Younger	18	13	16	16	63
		Older	20	17	19	17	73
2012	2012-2013	Younger	18	15	17	14	64
		Older	17	11	18	13	59
2013	2013-2014	Younger	16	15	18	18	67
		Older	14	14	13	16	57
2014	2014-2015	Younger	14	13	15	15	57
		Older	19	18	14	13	64
2015	2014-2015	Younger	15	13	10	11	49
		Older	13	11	12	11	47
2016	2016-2017	Younger	18	16	16	12	62
		Older	16	17	13	18	64
Σ			253	234	244	234	965

3 <sup>1</sup>Year – the year adopted for lactation duration during the investigated period.

4 <sup>2</sup>Year U – the real time of test-day recording.

5 **Supplementary Table S2.** Average 305-day milk yields of first-lactation cows according to age  
6 group and calving season between 2009 and 2015

Season	Younger		Older	
	Mean	SD	Mean	SD
1	8723	1031	8955	1052
2	9047	1081	9288	1072
3	9220	1123	9489	1111
4	8757	1117	9076	1184
Total	8926	1085	9192	1101

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8 **Supplementary Table S3.** The seasonal auto-regressive integrated moving average (SARIMA)  
 9 models, from which the best ones were selected for **prediction** (the best model for each season is  
 10 underlined)

	<i>MAE</i> <sup>1</sup>	<i>RMSE</i> <sup>2</sup>	<i>MAPE</i> <sup>3</sup>	<i>Q</i> <sup>4</sup>	<i>AIC</i> <sup>5</sup>	<i>AIC<sub>c</sub></i> <sup>6</sup>
Younger Primiparae						
Season 1						
<u>(010) (200)</u>	1.06	1.38	3.98	23.67	12.27	16.27
(010) (100)	1.11	1.52	4.10	22.96	14.04	16.35
(011) (200)	1.15	1.33	4.16	20.22	13.70	21.70
(100) (100)	1.16	1.36	4.37	15.67	13.25	17.25
Season 2						
(010) (200)	1.92	2.37	7.20	19.72	23.28	27.28
(100) (100)	1.49	1.76	5.42	27.17	21.46	25.46
<u>(100) (101)</u>	1.43	1.56	5.03	14.01	16.91	24.91
(100) (200)	1.49	1.76	5.19	15.52	17.37	25.37
Season 3						
(011) (100)	4.51	4.90	19.22	14.04	37.20	41.20
(100) (001)	2.19	2.71	8.05	34.85	25.92	29.92
(100) (100)	2.15	2.37	8.46	13.18	23.45	27.45
<u>(100) (101)</u>	1.23	1.54	4.37	8.81	16.58	24.58
Season 4						
(100) (002)	4.13	4.49	13.60	19.53	36.60	44.60
(100) (100)	2.86	3.17	9.91	17.40	29.11	33.11
(100) (101)	3.16	3.39	10.80	20.99	32.45	40.45
<u>(110) (100)</u>	1.55	1.86	5.73	17.34	22.17	26.17

12 **Supplementary Table S3.** Cont.

	<i>MAE</i>	<i>RMSE</i>	<i>MAPE</i>	<i>Q</i>	<i>AIC</i>	<i>AIC<sub>c</sub></i>
Older Primiparae						
Season 1						
(001) (200)	1.44	1.70	4.55	29.96	18.62	26.62
<u>(010) (200)</u>	1.47	1.60	4.54	20.65	18.39	22.39
(100) (101)	3.01	3.38	10.51	33.65	32.36	40.36
(100) (102)	2.03	2.46	6.94	18.12	28.06	43.06
Season 2						
(001) (100)	1.50	1.72	5.07	19.60	18.22	22.22
(010) (100)	3.34	3.95	12.29	16.63	30.19	31.10
<u>(010) (101)</u>	0.53	0.64	1.77	17.57	-4.97	-0.97
(100) (101)	0.93	1.03	3.15	18.35	19.41	27.41
Season 3						
(001) (002)	4.06	4.74	13.87	24.32	37.16	45.16
(100) (101)	2.79	3.41	9.06	19.59	32.47	40.47
<u>(100) (200)</u>	2.60	3.38	8.23	25.96	32.34	40.34
(111) (101)	2.36	3.22	7.34	15.45	33.40	48.40
Season 4						
(010) (002)	2.78	3.02	10.85	21.08	28.10	32.10
<u>(010) (200)</u>	1.48	2.20	5.39	22.48	21.57	25.57
(100) (002)	4.38	6.28	11.88	20.63	44.75	52.57
(100) (100)	2.72	3.64	8.20	12.71	31.78	35.78

13 <sup>1</sup>Mean absolute error.

14 <sup>2</sup>Root-mean-square error.

15 <sup>3</sup>Mean absolute percentage error.

16 <sup>4</sup>Q statistics.

17 <sup>5</sup>Akaike Information Criterion.

18 <sup>6</sup>Corrected Akaike Information Criterion.

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21 **Supplementary Table S4.** The parameters of the seasonal auto-regressive integrated moving average  
 22 (SARIMA) models selected for **prediction**

	Season		Constant	p(1)	q(1)	Ps(1)	Qs(1)	Ps(2)
Younger primiparae	1	(0,1,0) (2,0,0)				0.5116**	0.3211**	
	2	(1,0,0) (1,0,1)	3.3689**	0.4725**		0.9865**	0.7312**	
	3	(1,0,0) (1,0,1)	3.1176**	0.7140**		0.9526**	0.3398*	
	4	(1,1,0) (1,0,0)		-0.2594*		0.7974**		
Older primiparae	1	(0,1,0) (2,0,0)				0.2862*		0.6534**
	2	(0,1,0) (1,0,1)				0.9856**	0.6050**	
	3	(1,0,0) (2,0,0)	3.3921**	0.5171**		0.4074**	0.4885**	
	4	(0,1,0) (2,0,0)				0.5699**		0.3058*

23 \* p<0.05 and \*\*p<0.01

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25 **Supplementary Table S5a.** The differences between the real milk yields and those **predicted** by the SARIMA, NARX and Wood's  
 26 models (in kg and %) as well as the summary of the relative and absolute deviations calculated for each lactation stage according to  
 27 calving season and lactation stage (younger cows)

Stage	Season 1							Season 2						
	Real	SARIMA <sup>1</sup>		NARX <sup>2</sup>		Wood		Real	SARIMA		NARX		Wood	
		kg	%	kg	%	kg	%		kg	%	kg	%	kg	%
1	28.49	0.05	0.16	0.36	1.25	0.06	0.22	28.41	-1.62	5.72	-2.9	10.21	-2.74	-9.64
2	32.82	-0.03	-0.1	-1.77	5.38	0.23	0.69	32.57	-1.06	3.27	-2.75	8.43	-1.55	-4.75
3	32.74	-0.23	-0.7	-1.96	5.98	-0.69	-2.12	32.44	-1.95	6.01	-2.76	8.51	-1.91	-5.87
4	31.09	-0.99	-3.18	-1.54	4.95	-1.67	-5.36	32.12	0.97	3.03	-0.33	1.04	-1.29	-4.00
5	31.77	1.6	5.03	0.66	2.07	0.46	1.44	31.85	0.24	0.75	-0.47	1.49	-0.03	-0.09
6	30.78	1.49	4.85	0.71	2.29	1.33	4.32	30.09	1.06	3.51	-0.46	1.52	0.03	0.09
7	28.28	1.75	6.17	-0.79	2.81	0.87	3.09	27.16	-2.42	8.92	-2.59	9.54	-0.95	-3.51
8	26.57	0.14	0.51	1.51	5.68	1.28	4.82	24.06	-2.2	9.13	-2.42	10.05	-2.07	-8.61
9	21.83	-2.37	-10.9	-1.45	6.66	-1.38	-6.31	22.69	-1.53	6.72	-1.55	6.84	-1.49	-6.58
10	22.22	-2.05	-9.24	-0.11	0.5	1.03	4.64	21.42	-1.29	6.01	0.36	1.66	-0.86	-4.04
Mean	28.66	1.05	4.08	1.08	3.76	0.90	3.30	28.28	1.43	5.31	1.66	5.93	1.29	4.72
$\sum RD^3$		-30.31		-134.1		50.5			-292.39		-459.87		-376.35	

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$\Sigma AD^4$	330.88	324.26	225.2	428.63	484.77	377.99
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- 28 <sup>1</sup>Seasonal auto-regressive integrated moving average.
- 29 <sup>2</sup>Nonlinear autoregressive exogenous artificial neural networks.
- 30 <sup>3</sup>The sum of the relative deviations for the whole lactation (kg).
- 31 <sup>4</sup>The sum of the absolute deviations for the whole lactation (kg).
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35 **Supplementary Table S5b.** The differences between the real milk yields and those **predicted** by the SARIMA, NARX and Wood's  
 36 models (in kg and %) as well as the summary of the relative and absolute deviations calculated for each lactation stage according to  
 37 calving season and lactation stage (younger cows)

Stage	Season 3							Season 4						
	Real	SARIMA <sup>1</sup>		NARX <sup>2</sup>		Wood		Real	SARIMA		NARX		Wood	
		kg	%	kg	%	kg	%		kg	%	kg	%	kg	%
1	28.36	0.1	0.34	-1.82	6.41	-2.53	-8.93	28.29	1.19	4.2	-0.34	1.2	-0.78	-2.75
2	32.71	-1.17	3.58	-3.35	10.23	-1.97	-6.01	30.75	0.45	1.46	-4.32	14.06	-2.05	-6.67
3	33.53	0.02	0.05	-1.59	4.74	-1.66	-4.96	30.36	-0.96	3.16	-3.29	10.83	-3.18	-10.47
4	31.43	-2.2	7.01	-1.63	5.18	-2.84	-9.04	28.32	-1.71	6.05	-3.66	12.92	-4.61	-16.26
5	31.59	-0.07	0.21	-0.3	0.96	-1.04	-3.31	28.71	-0.64	2.22	-2.08	7.26	-2.90	-10.11
6	31.32	1.67	5.34	0.76	2.42	0.68	2.19	27.39	-1.43	5.22	-1.86	6.8	-2.55	-9.31
7	28.84	2.16	7.48	1.34	4.65	0.36	1.26	26.81	-1.01	3.78	-2.1	7.85	-1.27	-4.72
8	26.44	1.36	5.13	0.86	3.25	0.15	0.57	24.05	-3.67	15.27	-3.52	14.63	-2.09	-8.71
9	23.25	0.81	3.5	-1.55	6.67	-0.88	-3.76	21.47	-3.29	15.34	-3.19	14.87	-2.74	-12.78
10	19.27	-2.72	14.11	-2.56	13.29	-2.78	-14.41	20.19	-1.14	5.66	-2.07	10.24	-2.14	-10.60
Mean	28.67	1.23	4.67	1.58	5.78	1.49	5.44	26.63	1.55	6.24	2.64	10.07	2.43	9.24
$\Sigma RD^3$		-15.36		-298.84		-376.19			-378.41		-801.76		-736.07	



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$\sum AD^4$	381.19	476.43	385.1	464.78	801.76	736.07
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38 <sup>1</sup>Seasonal auto-regressive integrated moving average.

39 <sup>2</sup>Nonlinear autoregressive exogenous artificial neural networks.

40 <sup>3</sup>The sum of the relative deviations for the whole lactation (kg).

41 <sup>4</sup>The sum of the absolute deviations for the whole lactation (kg).

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44 **Supplementary Table S6a.** The differences between the real milk yields and those **predicted** by the SARIMA, NARX and Wood's  
 45 models (in kg and %) as well as the summary of the relative and absolute deviations calculated for each lactation stage according to  
 46 calving season and lactation stage (older cows)

Stage	Season 1							Season 2						
	Real	SARIMA <sup>1</sup>		NARX <sup>2</sup>		Wood		Real	SARIMA		NARX		Wood	
		kg	%	kg	%	kg	%		kg	%	kg	%	kg	%
1	29.93	-1.62	5.43	1.80	6.00	-1.05	-3.51	30.24	0.75	2.49	-1.07	3.54	-0.42	-1.36
2	34.80	-2.99	8.60	0.21	0.62	2.10	6.03	35.31	0.99	2.81	-0.01	0.02	0.89	1.95
3	33.64	-3.74	11.12	-1.06	3.14	-0.33	-0.98	34.29	-0.73	-2.12	-0.91	2.65	0.75	1.15
4	35.19	0.66	1.87	2.56	7.28	-1.12	-3.35	33.42	0.45	1.35	0.97	2.89	-0.49	-1.40
5	35.14	1.10	3.12	4.03	11.46	-1.05	-3.07	33.44	0.93	2.80	1.12	3.34	-0.42	-0.95
6	34.60	1.58	4.56	4.53	13.08	-0.22	-0.72	31.17	-0.12	-0.37	0.62	2.00	-0.54	-0.32
7	30.52	-1.52	4.99	1.45	4.73	0.81	2.86	29.99	0.06	0.19	0.24	0.80	0.50	-1.71
8	27.98	-1.30	4.65	2.92	10.44	0.81	3.08	28.37	-0.10	-0.36	1.89	6.67	0.24	0.88
9	27.14	0.90	3.31	3.86	14.21	0.60	2.44	26.03	-0.39	-1.50	1.79	6.87	0.92	3.68
10	23.87	-0.57	2.40	1.54	6.45	-1.08	-4.77	22.73	-0.84	-3.68	1.67	7.33	-0.41	-1.80
Mean	31.28	1.60	5.00	2.39	7.74	0.92	3.08	30.50	0.54	1.77	1.03	3.61	0.56	1.52
$\sum RD^3$		-220.43		653.55		-15.86			22.49		202.93		30.44	

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$\sum AD^4$	474.25	716.96	234.39	161.29	311.33	167.70
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- 47 <sup>1</sup>Seasonal auto-regressive integrated moving average.
- 48 <sup>2</sup>Nonlinear autoregressive exogenous artificial neural networks.
- 49 <sup>3</sup>The sum of the relative deviations for the whole lactation (kg).
- 50 <sup>4</sup>The sum of the absolute deviations for the whole lactation (kg).
- 51

52 **Supplementary Table S6b.** The differences between the real milk yields and those **predicted** by the SARIMA, NARX and Wood's  
 53 models (in kg and %) as well as the summary of the relative and absolute deviations calculated for each lactation stage according to  
 54 calving season and lactation stage (older cows)

Stage	Season 3							Season 4						
	Real	SARIMA <sup>1</sup>		NARX <sup>2</sup>		Wood		Real	SARIMA		NARX		Wood	
		kg	%	kg	%	kg	%		kg	%	kg	%	kg	%
1	34.96	3.92	11.22	4.78	13.68	1.29	3.69	27.42	-0.08	0.28	-1.21	4.41	-0.60	-2.20
2	31.21	-4.39	14.07	-4.85	15.53	-0.44	-1.41	30.75	-0.13	0.42	-4.32	14.06	1.21	3.92
3	37.33	1.05	2.80	2.21	5.92	1.13	3.03	28.32	-4.77	16.85	-5.33	18.81	0.45	1.60
4	35.34	0.01	0.03	2.28	6.46	-0.84	-2.37	30.28	0.06	0.21	-1.70	5.61	-1.13	-3.73
5	35.79	1.73	4.84	3.90	10.89	-1.53	-4.27	30.84	0.79	2.55	0.05	0.15	-0.61	-1.98
6	36.24	4.56	12.57	5.68	15.67	3.41	9.41	28.13	-0.22	0.78	-1.12	3.99	-0.31	-1.11
7	31.93	1.64	5.13	4.43	13.88	1.35	4.23	30.77	4.00	12.99	1.86	6.03	1.26	4.09
8	23.21	-7.01	30.18	-2.37	10.21	0.75	3.23	28.47	2.50	8.79	0.90	3.16	1.79	6.29
9	29.03	1.66	5.71	4.23	14.57	1.22	4.20	23.74	1.40	5.91	-0.92	3.88	-0.19	-0.80
10	25.27	0.06	0.26	3.44	13.61	-2.00	-7.91	21.37	0.90	4.20	-0.89	4.16	-0.50	-2.35

Mean	32.03	2.60	8.68	3.82	12.04	1.40	4.38	28.01	1.48	5.30	1.83	6.43	0.81	2.81
$\sum RD^3$		77.74		705.26		113,82			138.45		-379.01		41,28	
$\sum AD^4$		761.45		1138.28		320.15			449.52		547.19		218.03	

55 <sup>1</sup>Seasonal auto-regressive integrated moving average.

56 <sup>2</sup>Nonlinear autoregressive exogenous artificial neural networks.

57 <sup>3</sup>The sum of the relative deviations for the whole lactation (kg).

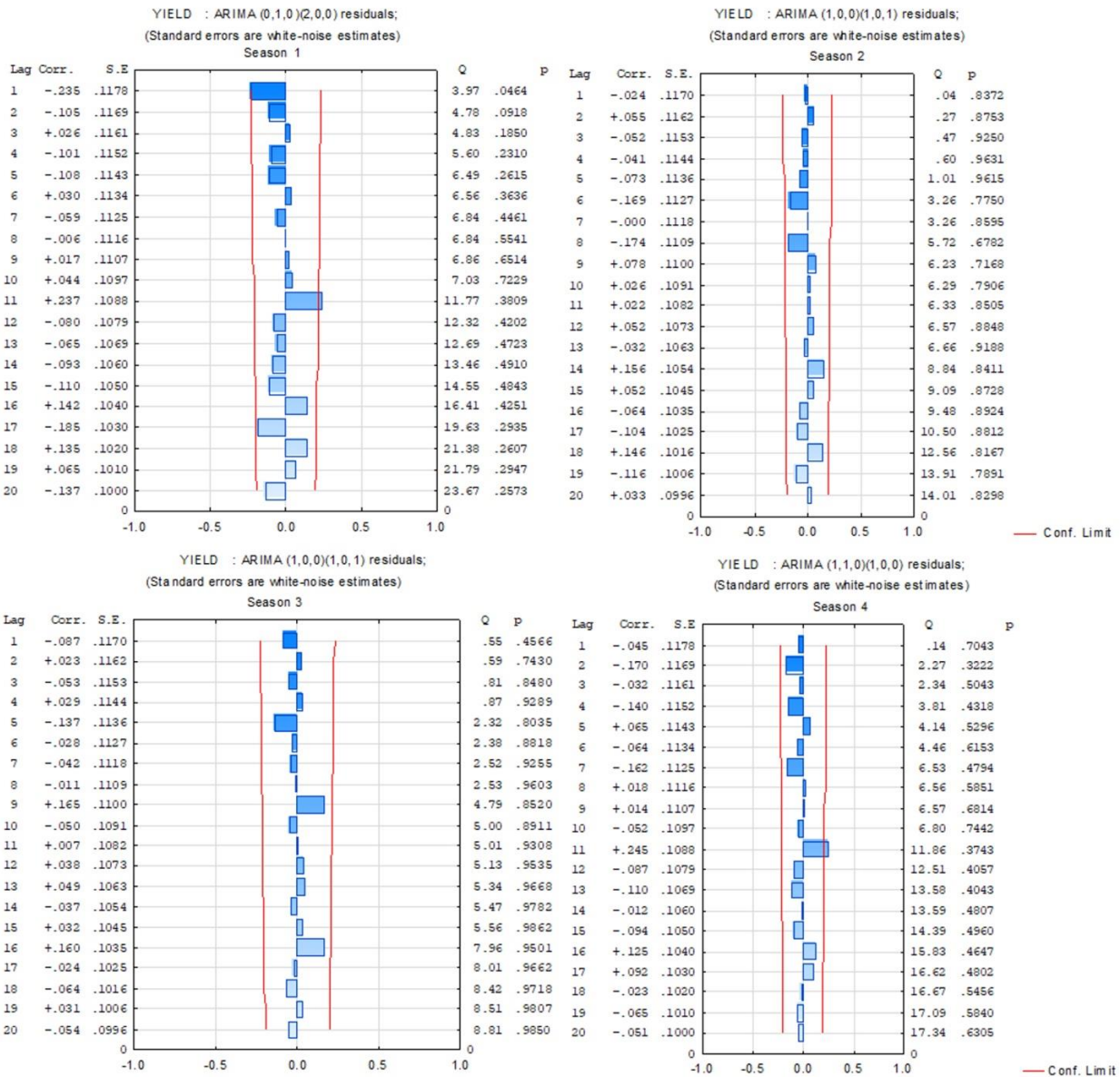
58 <sup>4</sup>The sum of the absolute deviations for the whole lactation (kg).

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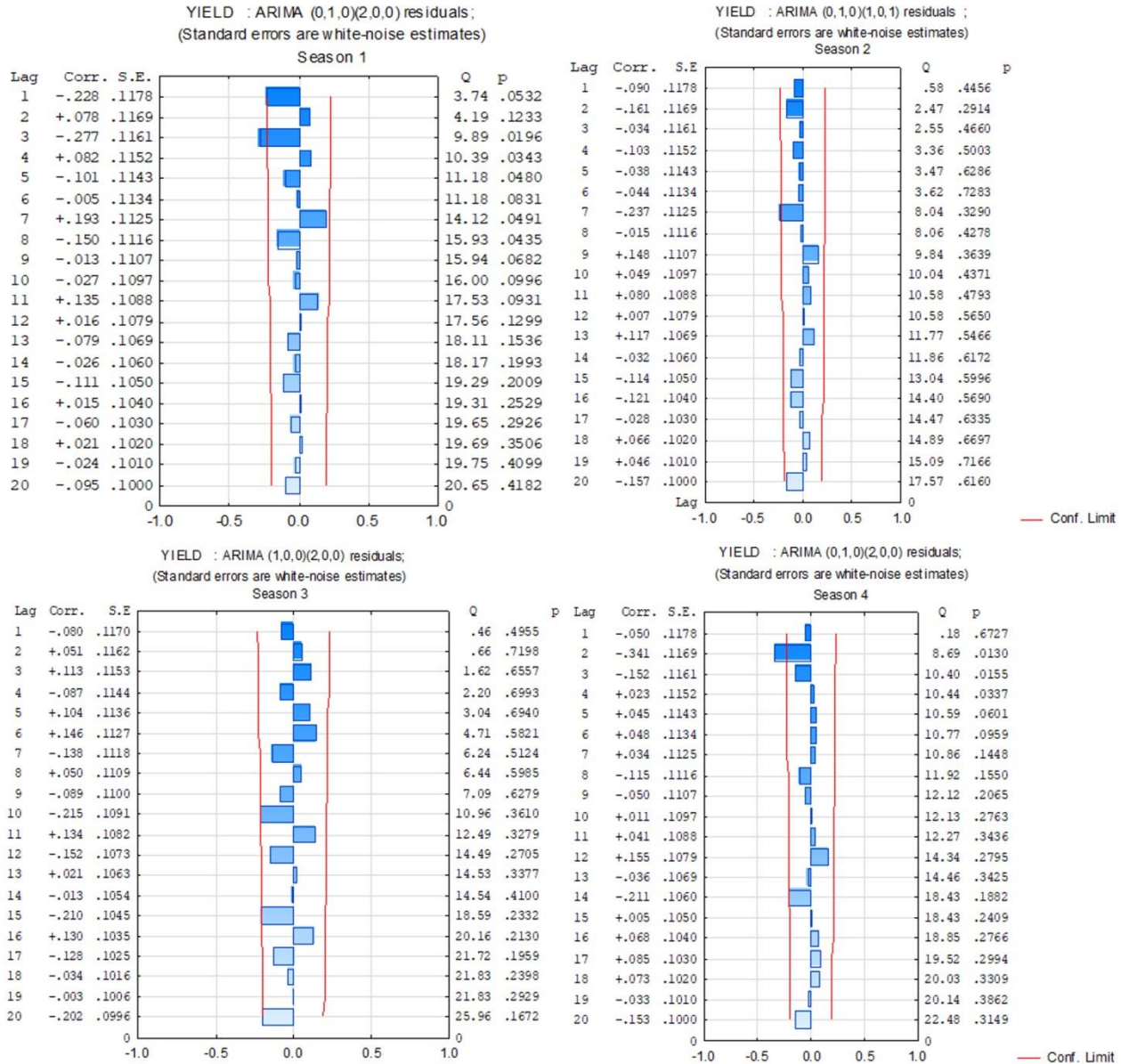
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65 Supplementary Fig. S1A. The correlograms of the autocorrelation functions for the best selected  
66 SARIMA models for the younger primiparae (at the age of 20 – 26 months)

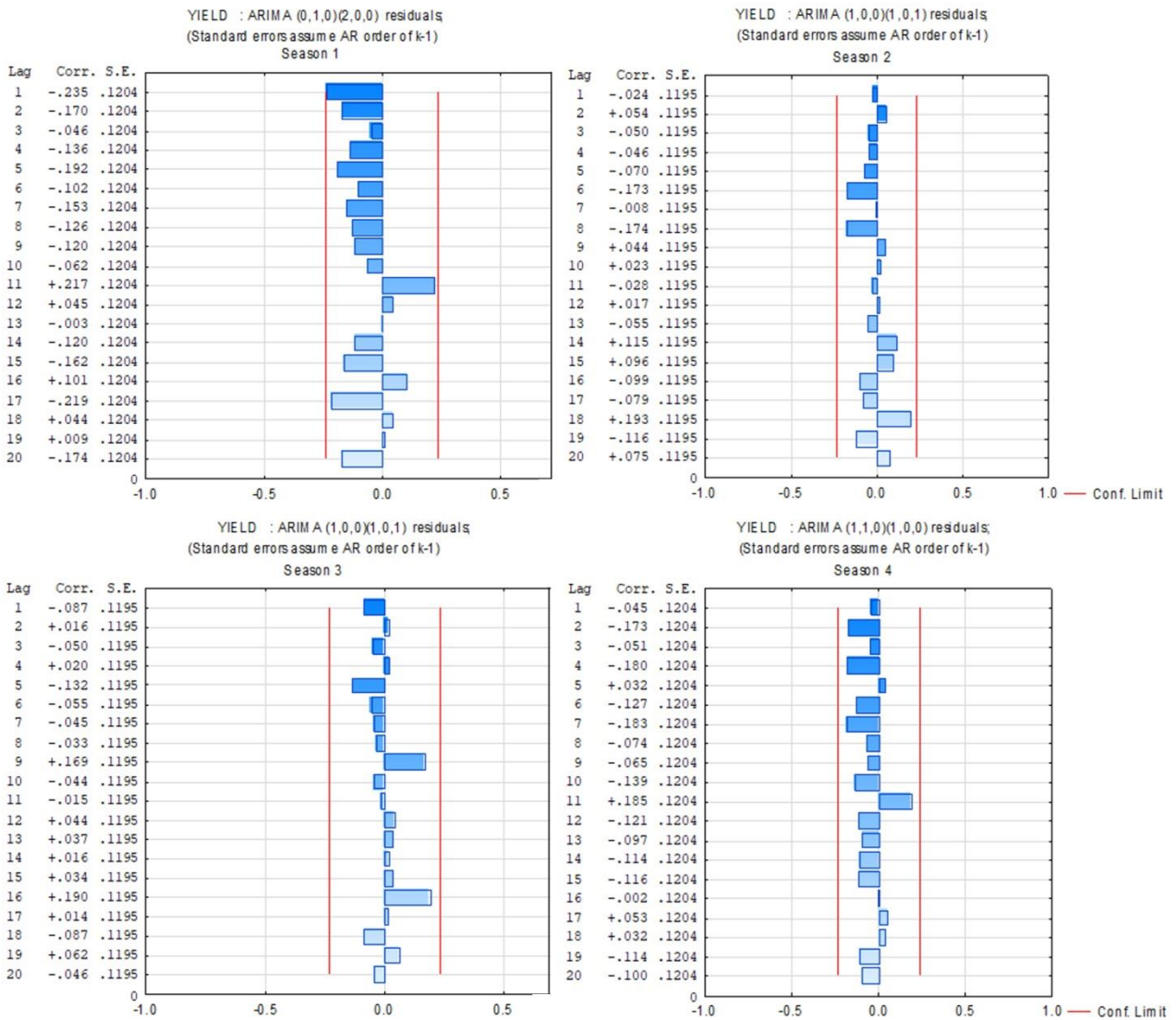


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70 Supplementary Fig. S1B. The correlograms of the autocorrelation functions for the best selected

71 SARIMA models for the older primiparae (at the age of 27 – 32 months)

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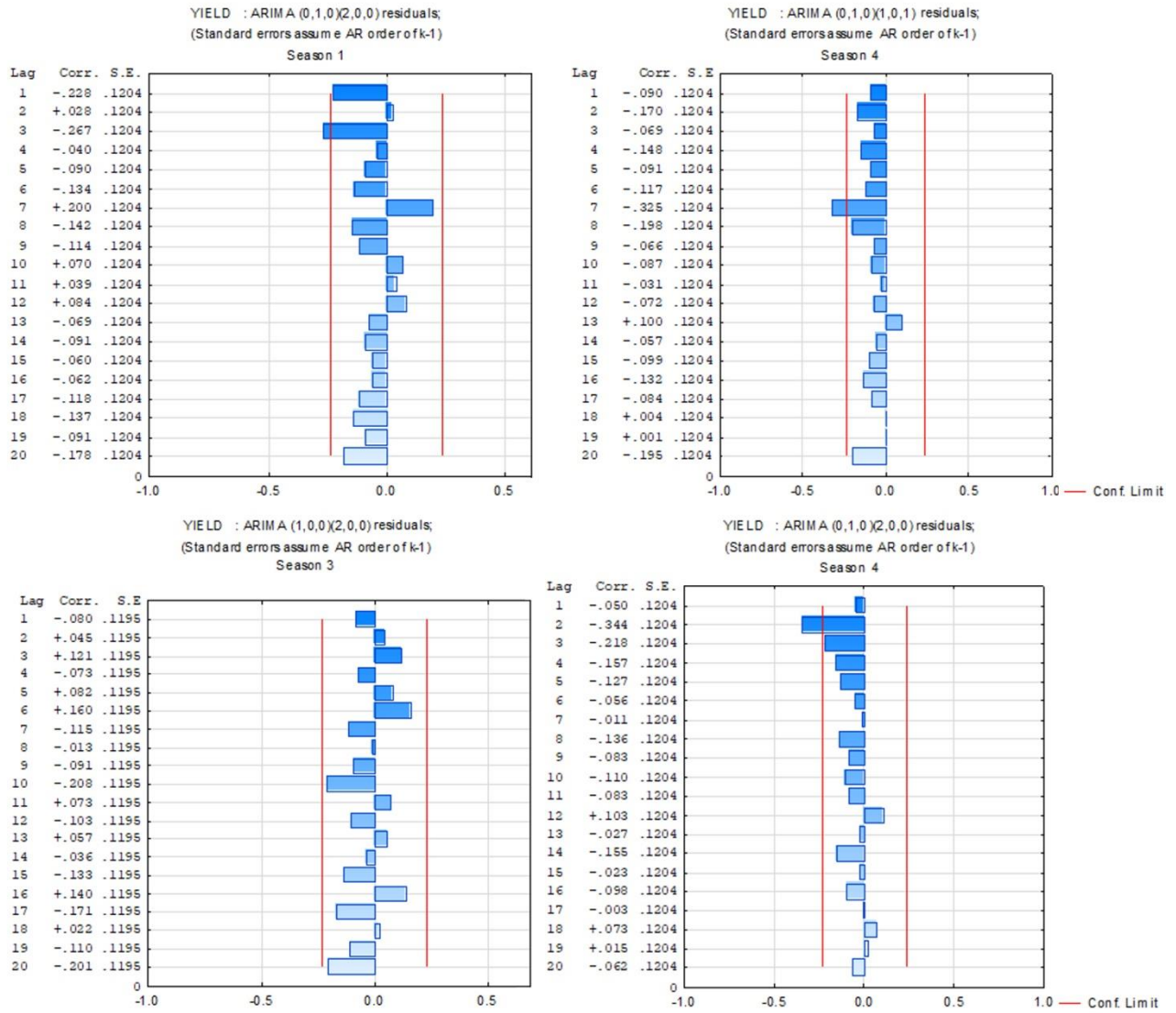
74 Supplementary Fig. S2A. The correlograms of the partial autocorrelations for the best selected

75 SARIMA models for the younger primiparae (at the age of 20 – 26 months)

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79 Supplementary Fig. S2B. The correlograms of the partial autocorrelations for the best selected

80 SARIMA models for the older primiparae (at the age of 27 – 32 months)

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