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Forecasting N.S.W. Beef Production : A Reply

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Revell (1981) has expressed some concern at the Box-Jenkins model used in evaluating the performance of alternative techniques for forecasting N.S.W. beef production (Gellatly 1979). Since model selection for univariate ARIMA estimation is ultimately based on subjective analysis of the data including autocorrelations and partial autocorrelations, the approach taken in this reply is to estimate alternative ARIMA models and to compare their forecasting ability.

The autocorrelations and partial autocorrelations for both the original data and first differences are presented in Tables 1 and 2 below.[1]

The original model chosen (Model 1) specified no differencing with a first order autoregressive parameter and a seasonal autoregressive parameter of order 4 (Gellatly 1979).

Revell (1981) suggested that a more parsimonious model (Model 2) might be appropriate, in particular a random walk model.[2]

The only autocorrelations and partial autocorrelations of the first differences significantly different from zero are those of lag 2 and 4 suggesting a seasonal autoregressive of order 2. This model (Model 3) was then estimated and the residual autocorrelations obtained. The Q statistic indicated that the hypothesis of the model residuals being white noise could not be rejected, *i.e.* no residual autocorrelations were significantly different from zero.

The model was also identified using a specialised computer programme[3] which automatically selects appropriate model parameters according to a set of "built in" rules. This programme selected a model (Model 4) with a first difference, a seasonal autoregressive of order 2 and a seasonal moving average of order 20.[4]

A number of transformations of the data series were evaluated, including the logarithmic transformation, however, the model results were less satisfactory. Therefore, four univariate Box-Jenkins models have been selected for comparison. The four models and their estimated parameters are:

Model 1

$$(1 - \varnothing B)(1 - \Phi B^4)(X_t - \bar{X}) = a_t$$

where	$\varnothing$ = 0.8912	Φ = 0.4446	$\bar{X}$ = 83,527
	SE = 0.0744	SE = 0.1360	SE = 22,352
	t = 11.98	t = 3.27	t = 3.74

Residual standard error = 9,217 (61 df)
Q = 22.25 (33 df)

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[1] An error was found in the data used for the Box-Jenkins model estimation. The revised data base has 69 observations, and the autocorrelations and partial autocorrelations show the same pattern. The Forecasting Committee and regression model forecasts are not affected.

[2] This type of model is in fact the naive alternative used in the forecasting evaluation.

[3] Computer Sciences of Australia (1978), *AUTOBJ*, Sydney.

[4] However, an examination of the autocorrelation and partial autocorrelations of the first differenced data and the estimated residuals from model 3 does not seem to provide justification for the addition of the seasonal moving average parameter.

Table 1: Sample Autocorrelation Functions

Original Series												
Lags												
1-12	.83	.65	.59	.55	.44	.39	.41	.42	.35	.28	.21	.16
ST.E.	.12	.19	.22	.24	.26	.27	.28	.28	.29	.30	.30	.30
13-24	.09	-.01	-.07	-.05	-.06	-.11	-.11	-.05	-.05	-.10	-.10	-.06
ST.E.	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31
25-36	-.09	-.14	-.13	-.08	-.05	-.06	-.06	-.05	-.02	-.01	-.03	-.04
ST.E.	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31
First Difference												
Lags												
1-12	.02	-.37	-.12	.38	-.09	-.26	-.06	.16	.00	-.01	-.06	.15
ST.E.	.12	.12	.14	.14	.15	.15	.16	.16	.16	.16	.16	.16
13-24	.06	.01	-.20	.13	.02	-.16	-.20	.29	.12	-.18	-.14	.29
ST.E.	.17	.17	.17	.17	.17	.17	.17	.18	.18	.18	.19	.19
25-36	.07	-.16	-.14	.12	.09	.01	-.10	-.04	.03	.16	-.07	-.06
ST.E.	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20

Table 2: Sample Partial Autocorrelations

Original Series												
Lags												
1-12	.83	-.11	.25	.01	-.14	.17	.10	.05	-.17	-.00	-.18	.06
13-24	-.10	-.18	-.00	.09	-.03	-.07	.19	.06	-.02	.00	.08	-.03
25-26	-.10	-.01	-.03	.04	.00	-.06	-.06	.01	.09	.06	-.04	-.06
First Difference												
Lags												
1-12	.02	-.38	-.12	.28	-.23	-.06	-.07	-.10	.03	.09	-.10	.18
13-24	.02	.02	-.10	.15	-.11	-.14	-.05	.16	-.04	-.04	.00	.06
25-36	-.00	.01	-.02	-.05	.12	.05	.03	-.09	-.05	.11	.03	-.01

Table 3: Box-Jenkins Model Forecasts

Forecast Time Period	Actual	Model 1 Forecast	Model 1 % Error	Model 2 Forecast	Model 2 % Error	Model 3 Forecast	Model 3 % Error	Model 4 Forecast	Model 4 % Error
1	121,261	127,651	5.27	125,516	3.51	119,904	- 1.12	121,697	0.36
2	130,993	118,185	- 9.78	121,261	- 7.43	121,129	- 7.53	121,016	- 7.62
3	134,624	133,740	- 0.66	130,993	- 2.70	132,600	- 1.50	136,952	1.73
4	128,412	131,235	2.20	134,624	4.84	130,951	1.98	127,547	- 0.67
5	127,437	123,667	- 2.96	128,412	0.77	127,042	- 0.31	130,740	2.59
6	157,676	128,812	-18.31	127,437	-19.18	129,782	-17.69	133,809	-15.14
7	167,141	153,520	- 8.15	157,676	- 5.95	158,044	- 5.44	165,699	- 0.86
8	161,101	157,755	- 2.08	167,141	4.04	155,729	- 3.33	158,323	- 1.72
9	150,540	154,400	2.56	161,101	7.02	157,529	4.64	162,320	7.83
10	149,886	158,818	5.96	150,540	0.44	152,820	1.96	154,396	3.01
	Mean absolute percentage error		5.79		5.59		4.55		4.15
	U		1.01		1.00		0.79		0.64

Model 2

$$(1 - B)\, X_t = a_t$$

Model 3

$$(1 - \Phi B^2)(1 - B)\, X_t = a_t$$

where $\Phi = -0.3774$
SE = 0.1194
t = -3.17

Residual standard error = 9,396 (65 df)
Q = 37.77 (35 df)

Model 4

$$(1 - \Phi B^2)(1 - B)\, X_t = (1 - \Theta B^{20})\, a_t$$

where $\Phi = -0.3066$, SE = 0.1234, t = -2.48; $\Theta = -0.4055$, SE = 0.1763, t = -2.30

Residual standard error = 8,964 (64 df)
Q = 19.66 (34 df)

The four estimated models we then used to obtain forecasts for the ten quarters beginning November 1975-January 1976. The one period ahead forecasts were updated making use of new data as it became available. The final forecasts obtained from the four Box-Jenkins models are given in Table 3.

The U coefficients indicate that the model suggested by Revell (Model 2) is little different in forecasting ability to the original model (Model 1). However, Models 3 and 4 have superior forecasting ability to Models 1 and 2, and to the Forecasting Committee, over the evaluation period.

Over the past two years both a revised Box-Jenkins model and a revised regression model have been used by the author as an input for the Forecasting Committee when determining their forecasts. This experience has reinforced the fact that the use of modelling techniques in practical forecasting is a continuing process of updating and respecification in the light of new information and evaluation of past forecasting errors.

References

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