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Enabling Users to Evaluate the Accuracy of ABARES Agricultural Forecasts[1]

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Abstract

This paper describes the development of an online database which allows users to assess the accuracy of ABARES agricultural market forecasts for around 100 variables over nearly two decades. Accuracy underpins the broader quality dimensions of ABARES forecasts such as institutional alignment and value-in-use to end users. The accuracy of ABARES forecasts generally improves as the lead time between forecast and outcome reduces, and production forecasts are slightly more accurate than corresponding price or export forecasts. Overall results show that ABARES forecasts are generally unbiased, but that bias can be a transient issue in markets undergoing structural change. The ability to analyse accuracy at low cost is a foundational step towards future research into the value of ABARES forecasts for supporting decision making.

Key words: ABARES, agriculture, commodities, markets, accuracy, quality

Introduction

The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) has been producing quarterly forecasts for Australia's agricultural commodity markets since 1948. A description of the forecasting system used to produce these forecasts, the Australian Agricultural Forecasting System (AAFS), and a critique of design choices over more than 70 years has been provided in a companion paper in this journal (Nelson *et al.*, 2022a). Both papers report aspects of a project that ran from 2017 to 2022 to review and modernise ABARES agricultural commodity forecasting methodologies. This paper describes one of the largest sub-projects of the transformation project - the development of an online database which enables users to assess the accuracy of forecasts for around 100 variables over nearly two decades. Enabling forecast users to explore the accuracy of ABARES forecasts helps to instil confidence regarding their use and helps to broaden assessments of

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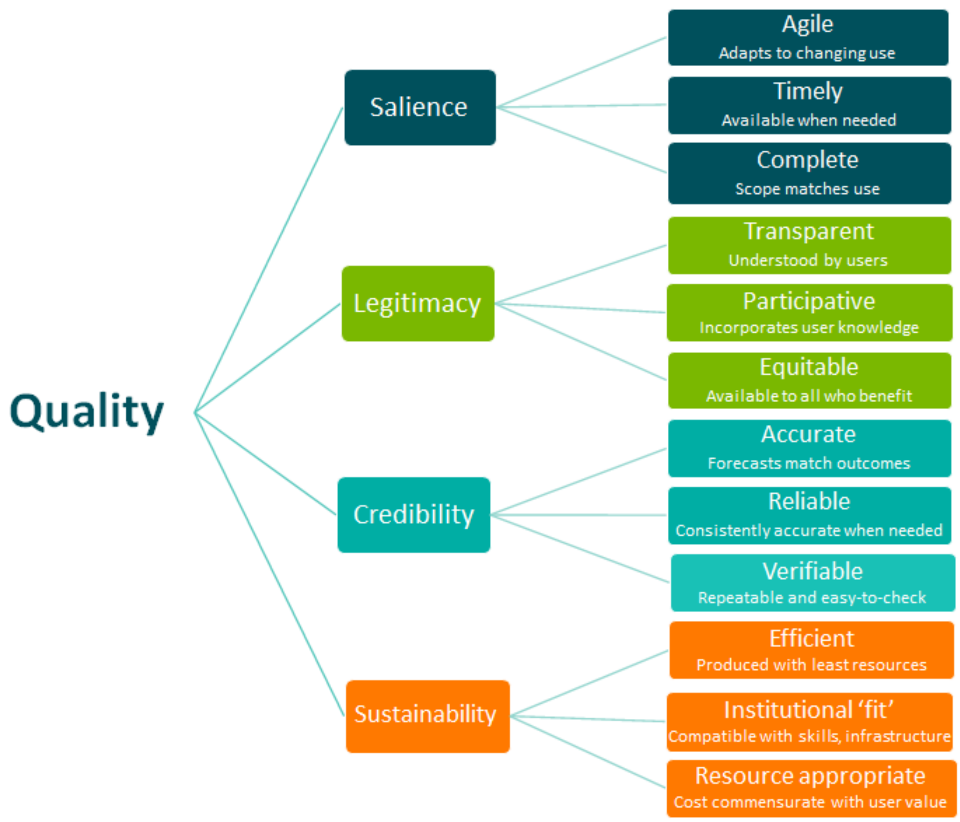
[1] The data contained in the first release of this database was collected manually from 160 historical publications which span a 20-year period. This was a very significant effort spanning many months. The authors particularly thank Benjamin Agbenyegah, Amelia Brown, Mikayla Bruce, Emily Dahl, Matthew Howden, Peter Lock, Chris Mornement, Nathan Pitts, Damien Thomson, Tim Whitnall, Charley Xia and Kirk Zammit for their contribution to collecting, assembling and verifying this data.

forecast quality from narrow quantitative measures of accuracy towards broader assessments of their usefulness for supporting decision making. This paper describes the development of the online database and examples of its use to evaluate the changing accuracy of ABARES forecasts over time.

Forecast Quality

As discussed in the companion paper (Nelson *et al.*, 2022a), ABARES evaluates the performance of AAFS from three perspectives: the ability of the system to produce accurate forecasts, the ability of the system to meet changing institutional objectives (see Nelson, 2018), and the value–in–use of its forecasts to diverse end-users (see Nelson *et al.* (2022b) for details). This combined approach overcomes the resource-contingent limitations of using accuracy as the main quality parameter of forecasting systems. It may be possible to improve forecast accuracy but doing so tends to encounter diminishing returns to increased forecasting effort (Kingma *et al.,* 1980). Accuracy may also not be the most important factor limiting the value of forecasts for decision making (Cash *et al.,* 2003). Textbook lists of broader criteria for evaluating information quality are common and usually include availability, accuracy, timeliness, reliability and relevance (Stair & Reynolds, 2018) (Figure 1). These basic quality criteria are widely adopted, including in Australia's national data standards (ABS, 2009). While these broader quality dimensions are important, the accuracy of forecasts is fundamental to their usefulness.

Figure 1. Quality dimensions of agricultural forecasts



Source: Cash *et al*. (2003), Longmire & Watts (1981)

Method

Database construction

In 2021 ABARES published an online database that forecast users can use to analyse the accuracy of the Bureau's agricultural forecasts for the years 2000 to 2019 (Cameron, 2021). The database contains forecasts and the actual outcomes for a wide range of time series variables. Each record in the database includes a detailed categorisation of the variable, the year and month that the forecast was issued, the year that the forecast was made for, and the actual outcome for that variable which was later observed. At any point in time some of the more recently issued records only contain forecasts as actuals are not yet known. The database was released in Microsoft Excel format to facilitate the inclusion of relevant release notes and metadata in the data file. The database itself is contained on a single tab of this file and uses a 'flat file' structure which enables easy ingestion into most common statistical analysis software.

The database is intended to support analysis of forecast accuracy for the included variables. Users can filter for variables of interest and calculate accuracy measures such as raw differences, absolute differences, percentage deviation, standard deviation, root mean square error or any other statistic of interest. Filtering also enables ready graphic representation of the data. Tables of summary statistics are released alongside the data for users who do not wish or need to interrogate the raw data themselves. The summary tables display symmetrical mean absolute percentage error, average absolute error, the smallest and largest individual misses for the series, and counts of under- and over-estimates for the duration of each time series.

The forecast variables included in the database were originally selected by considering their importance to Australian agriculture, their availability as long time series, and if they could be collected from digital publications. The year 2000 was chosen as the starting point for the series because this was the first year for which ABARES publications were digitised in a consistently accessible format. Publications from earlier periods are inconsistently available in older PDF file formats or scans of printed documents making the cost of collecting this data greater that the benefits. The year 2000 also represents a convenient turning point in the structure of Australia's agricultural industries in terms of a long transition from wool to grain production.

The database was constructed by a team of analysts who spent significant time collecting, cleaning and quality assuring the data. A staged sign-off procedure was followed for the entire initial collection, which involved several rounds of quality assurance checking against the original publications to ensure the data were identical to the initial publication.

Construction of the database necessitated the establishment of a tailored classification for the included variables. Variables are listed according to their:

- Commodity – 24 categories – a broad description of each commodity
- Estimate type – 7 categories – animal numbers, crop area, production (value and volume), exports (value and volume) and price
- Estimate description – 50 categories – a detailed description of each series, including type of commodity and location and grade for indicator prices
- Unit of measurement – 15 categories
- Region – 7 categories – Australia, Australian states and "world"

Each forecast is defined by this classification system and by the year and quarter in which it was made. No attempt was made at concordances to other commodity classifications, and this remains an opportunity for future development if linking series proves useful.

ABARES produces forecasts for all elements of the balance sheet and indicator prices for each commodity. Forecasts published in March are for the next five July-June financial years (March for the next year and the four following financial years). Forecasts published in June, September and December provide updates of forecasts for the next (June forecasts) and then current (September and December forecasts) July-June financial year. Forecasts are published online via the *Agricultural Commodities* publication which is released after midnight on the morning of the first Tuesday of March, the second Tuesdays of June and September and the first or second Tuesday of December. Release days are occasionally moved to account for Australian public holidays.

In most cases observed values are official estimates published by the ABS or market data from various government or commercial sources in the case of prices. This means that the resulting error estimates can combine errors associated with forecasting as well as errors associated with ABS estimation methodologies. For some variables ABARES forecasts can only be compared to ABS estimates calculated for slightly different purposes using different methodological assumptions. There is often lively debate about the accuracy of official statistics pertaining to agriculture, especially when trusted third–party data sources are available which appear to contradict the official estimates (McRobert *et al.,* 2019).

A procedure to periodically update the database as new forecasts are released and observations become available is under development but has not yet been implemented (as of July 2022). This will involve an automated process to extract the data each time a forecast is released, along with some quality assurance checks. The development of an update procedure is complicated by the bespoke data system ABARES uses to store and publish agricultural forecasts, which does not include a snapshot functionality as typically understood in information management disciplines (see for example Microsoft (2022)). It is likely that a significant degree of post-automation data checking by analysts familiar with the data will be required even if issues with the ABARES database software environment are addressed. Reasons for this include frequent changes to the format and content of data sources and changes in the selection of data series as forecasting methodologies and priorities evolve.

Choice of metric

The accuracy of forecasts is usually assessed by comparing a prediction to the corresponding outcome. This paper uses symmetric mean absolute percentage error to measure the accuracy of ABARES forecasts. This measure was chosen because of its intuitive communication of the scale of errors relative to the absolute size of actual values across diverse forecast variables, and because it does not penalise positive forecast errors more than negative forecast errors (Hyndman and Koehler, 2006). Hyndman and Koehler (2006) compared a range of metrics for evaluating forecasts and found that symmetric mean absolute error can be undefined when forecasting numbers close to zero. This has not proven to be an issue for this application. In the event that users encounter issues with the chosen metric, the database enables them to apply their own metrics, and a summary table provides a range of simple diagnostic statistics for important forecast variables.

Symmetric mean absolute percentage error (SMAPE) is calculated using the formula:

$$SMAPE = \frac{100\%}{n}\sum_{t=1}^{n}\frac{|F_t - A_t|}{(A_t + F_t)/2}$$

In this formula, F_t represents a forecast of a variable for period t, A_t is the actual or observed value for that period, and *n* is the number of years over which forecast accuracy is estimated. A simple average of the errors for an entire time series is used as the main summary statistic for each series in this paper. An example is shown in Table 1.

Table 1. Wheat export volume forecasts, issued September quarter

Financial year being forecast	Sept forecast for current FY (kt)	Actual value (kt)	Forecast error (%) (a)
2000–01	17,280	16,621	4%
2001–02	16,240	16,465	1%
2002–03	12,800	10,845	17%
2003–04	13,658	15,074	10%
2004–05	17,999	15,780	13%
2005–06	15,557	15,168	3%
2006–07	16,554	11,196	39%
2007–08	12,156	7,408	49%
2008–09	13,610	13,410	1%
2009–10	14,557	13,725	6%
2010–11	18,168	18,431	1%
2011–12	20,455	23,026	12%
2012–13	22,500	21,265	6%
2013–14	19,179	18,336	4%
2014–15	18,102	16,571	9%
2015–16	17,529	15,777	11%
2016–17	18,403	22,057	18%
2017–18	18,153	15,492	16%
2018–19	12,954	9,805	28%
2019–20	10,871	10,115	7%
Average forecast error for 2000–01 to 2019–20:			**13%**

Source: Author analysis using ABARES historical forecast database.
(a) Symmetrical mean absolute percentage error.

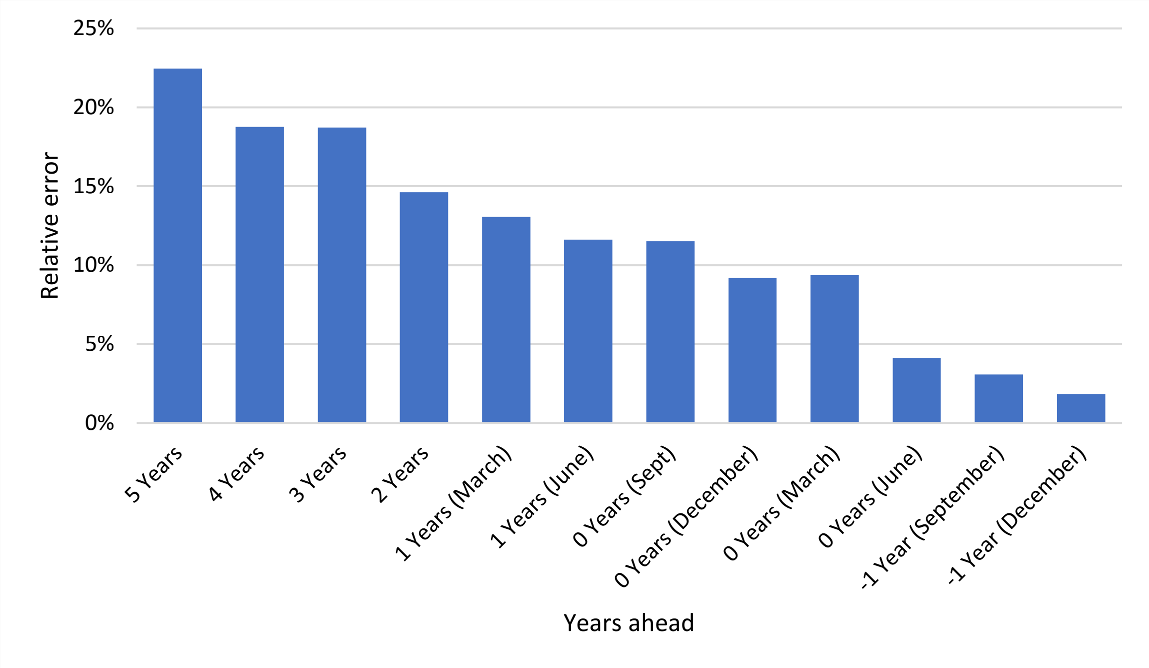
Results

Accuracy over time

The accuracy of ABARES forecasts generally improves as the lead time between forecast and outcome reduces. This is because more information becomes available to the forecaster and the degree of uncertainty about important contributing factors is reduced. Most time series included in this database exhibit the pattern shown in Figure 2, with the relative error falling as the forecasting horizon diminishes.

Relative errors for ABARES price forecasts issued in March for the coming financial year averaged 16 per cent across the included series. This falls to 11 per cent by September (issued in the first quarter of the financial year in question) and to 7 per cent by December. Relative errors for production volumes average 12 per cent in March and fall to 7 per cent by December. Relative errors for export volumes average 19 per cent in March and fall to 11 per cent by December.

Figure 2. Example of forecast accuracy over time - Skim milk powder production



Note: Australian dairy production volume data is released with a lag and is subject to revisions following release. This is partially responsible for the relative error shown for the backcast (-1 year) periods.
Source: Author analysis using ABARES historical agricultural forecast database

Summary statistics of forecasts made over the course of a calendar year, for all prices, volumes, values, areas and animal numbers contained in the database, are shown in Appendix A. The summary tables provided with the database also contain additional metrics of forecast performance such as counts of over- and under-prediction, and the average error of predictions for each series.

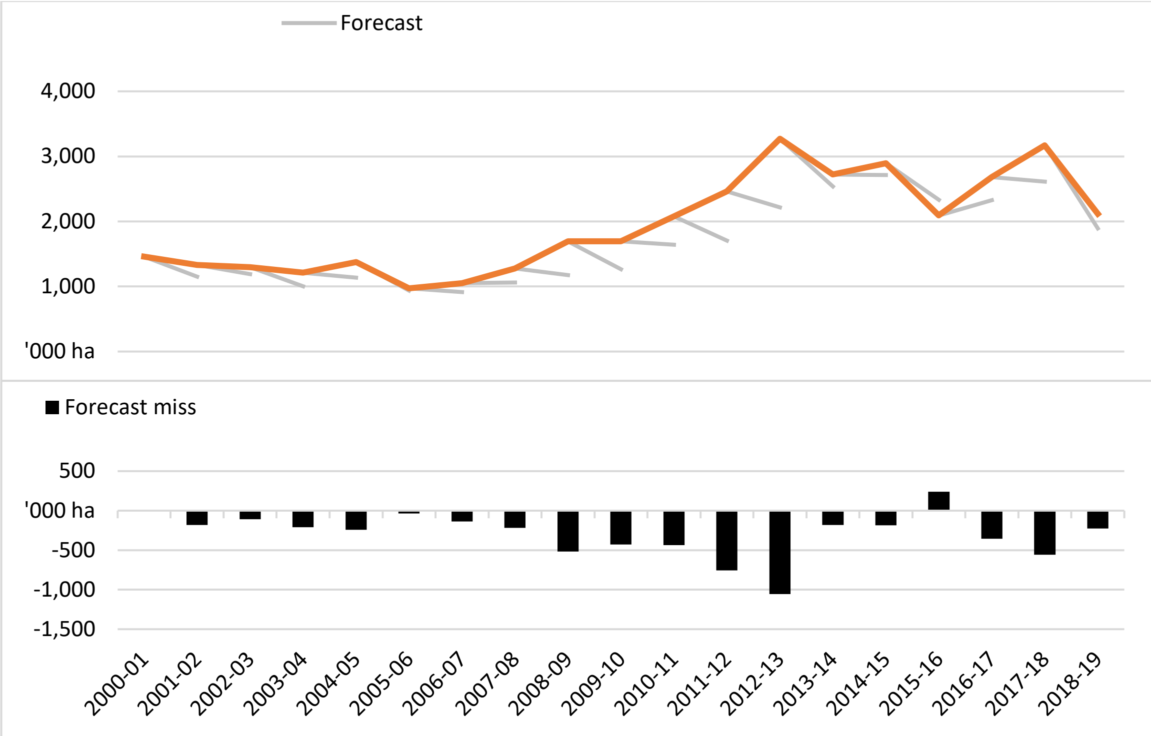
The longest time horizon for ABARES forecasts contained in the database is five years, with the shortest time horizon being for forecasts issued late in-year (forecasts issued in June for the financial year that ends on 30 June that year). The database also contains 'backcasts' for some series. Backcasts in this paper are defined as estimates made after the end of the period, but before the outcome is known. For instance, official crop production estimates for Australia are often not released by the Australian Bureau of Statistics until 12-18 months after harvest is completed. Backcasts are required for most agricultural time series. The only exception is market prices which are generally available in a timely manner. It is important to note that official estimates are just that – estimates – and so are themselves subject to sampling error and changes in coverage and accuracy over time (ABS, 2015).

Forecast bias

Across all observations contained in the dataset, ABARES forecasts exhibited a slight negative bias between 2000 to 2019. Of 14,508 observations in the first release that are forecasts, 54 per cent were lower than observed outcomes (negative bias), and 46 per cent were higher (positive bias). An important caveat on this result is that the database does not contain every forecast made by ABARES over the period and is also not a random sample of those forecasts.

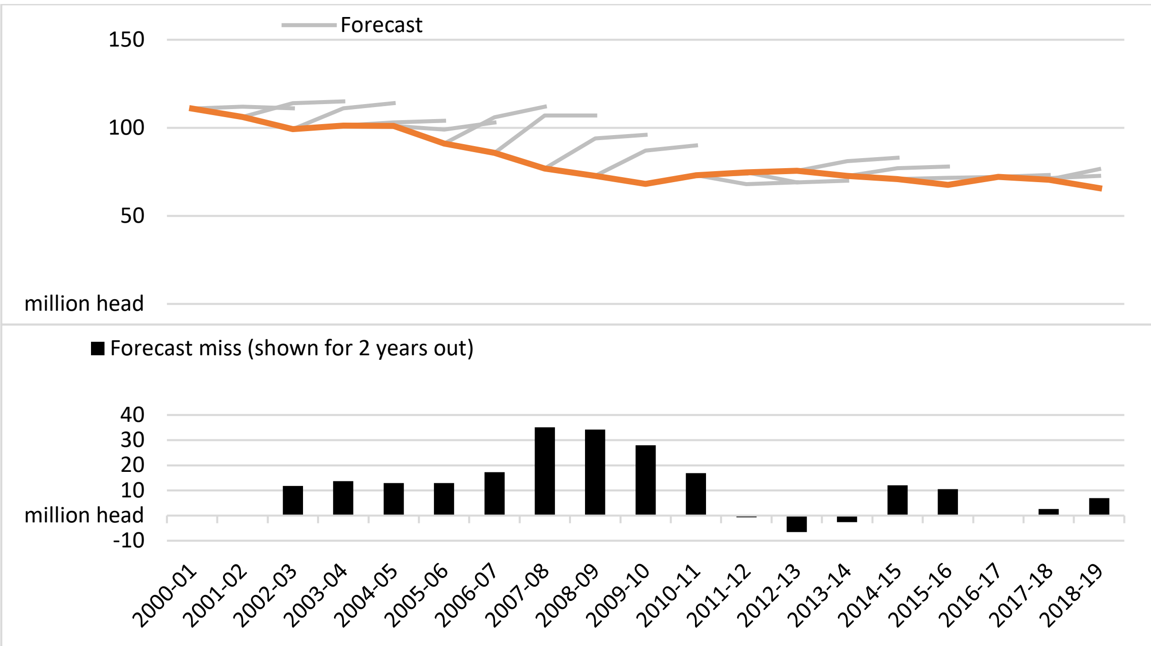
Examples of unbiased, positively biased and negatively biased forecasts can be found in many individual time series within the database. Examples are shown in Figures 3, 4 and 5.

Figure 3. Example of negative bias—Canola planted area



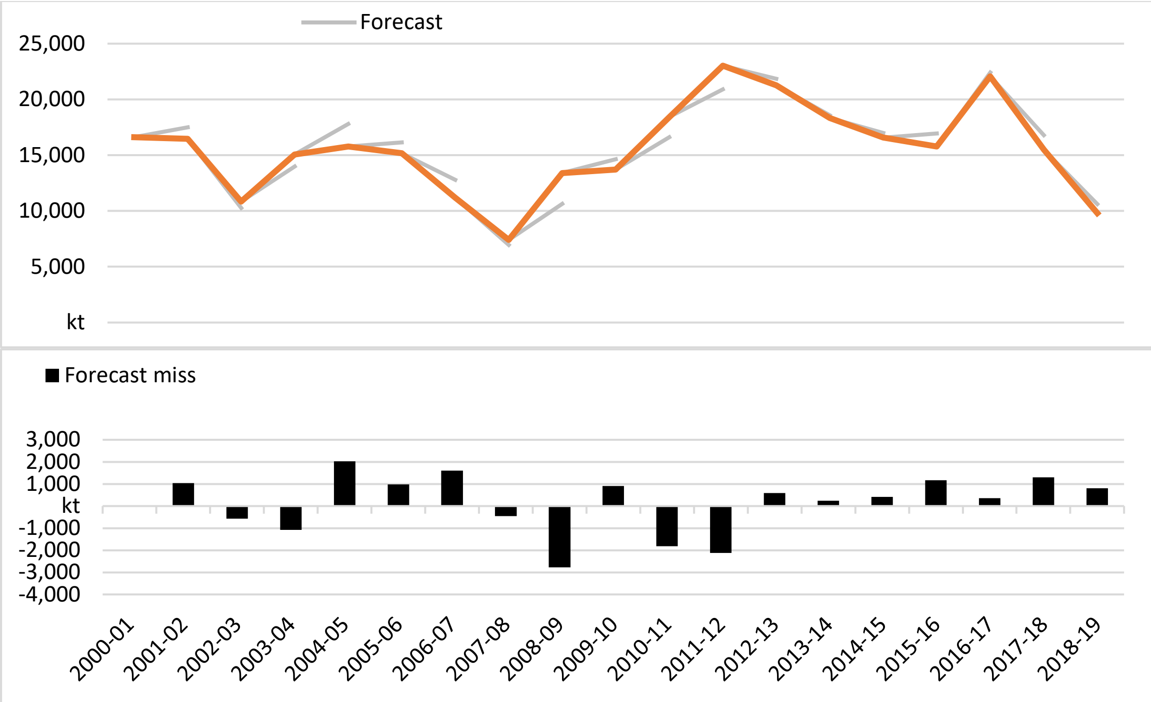
Note: Forecast issued in December quarter for current financial year. For example, issued in December 2010 for the 2010–11 financial year.
Source: Author analysis using ABARES historical agricultural forecast database

Figure 4. Example of positive bias—Sheep numbers



Note: Forecast issued in March quarter for the 2 financial years ahead. For example, issued in March 2010 for the 2011-12 and 2012–13 financial years.
Source: Author analysis using ABARES historical agricultural forecast database

Figure 5. Example of no apparent bias—Wheat export volume forecast



Note: Forecast issued in December quarter for current financial year. For example, issued in December 2010 for the 2010–11 financial year.
Source: Author analysis using ABARES historical agricultural forecast database

For example, Figure 3 reveals a degree of under-prediction of the adoption and yield of genetically modified canola varieties after their introduction in the mid to later 2000s. Figure 4 reveals over-prediction in the sheep flock following low wool prices induced by a stockpile accumulated during a period of price support in the early 1990s. The summary tables included with the database include counts of under- and over-prediction for every series in the historical forecast database.

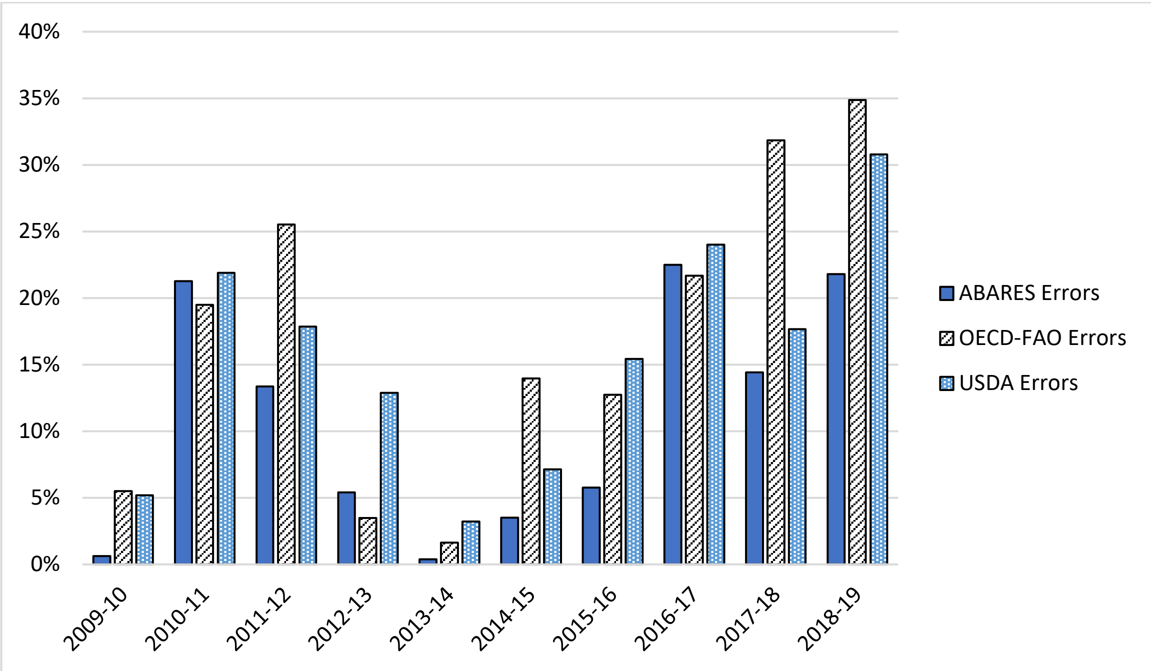
There are many reasons for forecast bias and so care should be taken in interpretation. Bias may arise from systematic factors or by chance (depending on the rigour of the indicator of bias chosen). Bias apparent in a single series may be the result of a poor specification or forecasting procedure, by systematic adoption of optimistic or pessimistic predictions (Armor and Sackett, 2006), or introduced by reliance on a biased exogenous input over which the forecaster has limited or no control (Abarbanell and Lehavy, 2003). Biases in a single forecast series (such as crop area) can contribute to biases in other dependent series (such as the area devoted to competing land uses). Historical series can also be revised, and so a forecast that would once have been accurate can become less accurate in hindsight when compared to a revised benchmark.

International comparisons

Several organisations issue forecasts for major Australian agricultural series. This allows comparisons of forecast accuracy between different forecasting agencies for the same time series. The following illustrative example compares the accuracy of forecasts of Australian wheat production and exports by three different public sector forecasting institutions. In interpreting this comparison, readers should bear in mind the differing importance and resources likely to have been committed to forecasting Australian agricultural production by these institutions.

Both the United States Department of Agriculture (USDA) and the OECD Food and Agriculture Organisation (OECD-FAO) produce forecasts of Australian crop production (Figure 6) and exports (Figure 7) (USDA, 2021; OECD-FAO, 2021). Both organisations also provide accessible archives of their historical forecasts. For illustrative purposes, these agencies' forecasts of Australian wheat production and exports are compared to ABARES' forecasts, for the period 2009–10 to 2018–19. This comparison period was chosen as the OECD-FAO historical database is only available from 2009. For consistency, the official Australian figures are used as the actual outcomes.

Figure 6. Relative forecast errors in Australian wheat production estimates issued June/July between 2009–10 and 2018–19



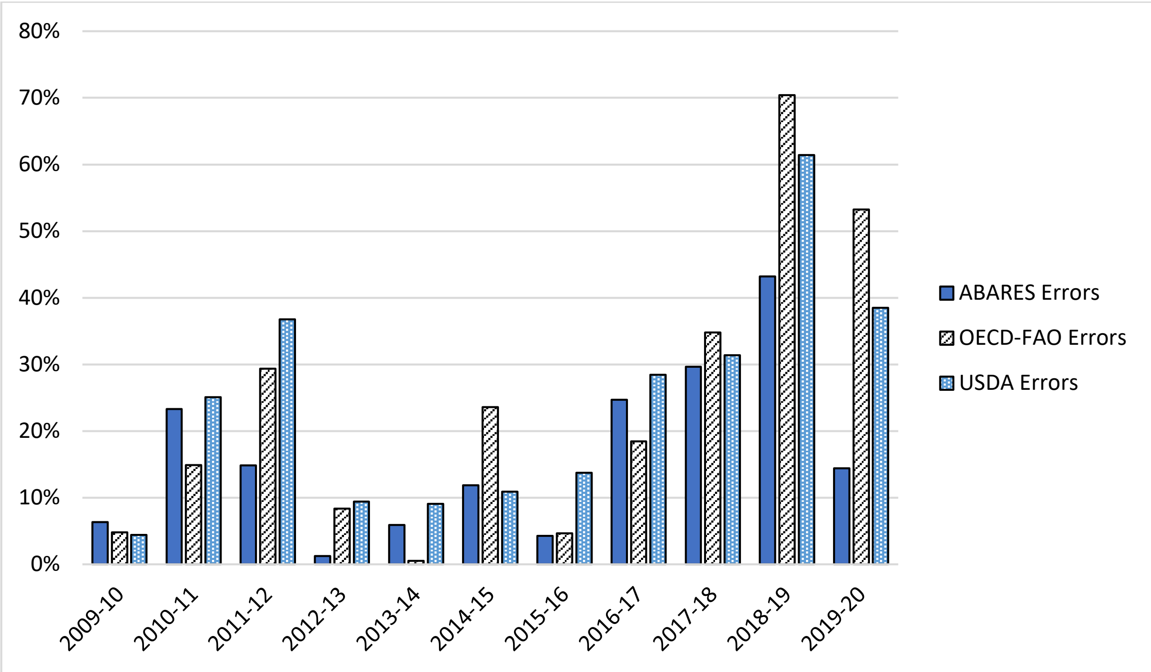
Notes: Last revised release used for WASDE data where relevant. OECD data downloaded from OECD.Stat service on 8 January 2020.
Sources: Author analysis using ABARES historical agricultural forecast database Cameron (2021), OECD-FAO (2022) and USDA (2021).

The OECD-FAO releases forecasts on an annual basis in mid-July. The USDA releases forecasts each month in the *World Agricultural Supply and Demand Estimates* (WASDE) publication. This analysis compares ABARES and USDA forecasts issued in June with the OECD forecast issued July, for the financial year ahead.

For the 10 observations available for production, ABARES average forecast error was 11 per cent, OECD-FAO 17 per cent, and USDA 16 per cent. ABARES forecasts had lower relative errors than the OECD-FAO forecasts in 7 out of 10 years, and lower relative errors than the USDA forecasts in every year of the analysis period.

For the 11 observations available for exports, ABARES average forecast error was 16 per cent, OECD-FAO 24 per cent, and USDA 24 per cent. ABARES forecasts had lower relative errors than the OECD-FAO forecasts in 7 out of 11 years, and lower relative errors than the USDA forecasts in 9 out of 11 years.

Figure 7. Relative forecast errors in Australian wheat export estimates issued June/July between 2009–10 and 2019–20



Notes: Last revised release used for WASDE data where relevant. OECD data downloaded from OECD.Stat service on 8 January 2020. Each agency's own historical data used to estimate errors shown in order to account for differences in marketing years. 2019–20 USDA estimate taken from January 2021 WASDE release. *Sources*: Author analysis using ABARES historical agricultural forecast database Cameron (2021), OECD-FAO (2022) and USDA (2021).

Differences in forecast performance for exports should be interpreted with caution. As each agency uses different 12-month aggregation periods for each year's exports, forecast errors each year may not be directly comparable. Each agency's own historical time series was used as the actual outcome measure in this analysis, in contrast to the ABS figures used for production estimates. This analysis should only be interpreted as providing a general sense of relative errors over time.

Discussion - Evaluating the Quality of ABARES Forecasts

Accuracy has often been regarded as the most fundamental quality dimension of agricultural forecasts in general (Allen, 1994), and of the agricultural forecasts produced by ABARES and its predecessor organisations (Freebairn, 1978). It was considered the most fundamental performance attribute adopted during a recent review of ABARES agricultural forecasting methodologies (Nelson *et al.*, 2022a). Early assessments of the accuracy of ABARES agricultural forecasts were included in Freebairn (1975, 1978) alongside broader reflections on the quality and purpose of these forecasts. Over the two decades or so leading up to 2019, ABARES published cursory annual assessments of forecast accuracy in each September edition of its *Agricultural Commodities* journal. Articles titled ‘Understanding ABARES agricultural forecasts’ compared forecasts and observed outcomes for selected international and domestic commodity prices and provided some post–hoc reasoning as to why the two differed (see for example ABARES (2016)). This was complemented for a decade or so from 1996 by the use of confidence intervals estimated by extrapolating past forecasts errors into the future (Penm & Neighbour, 1996).

Factors that contribute to the accuracy of ABARES forecasts include the stability of world markets, and the ABARES conservative approach to forecasting. The two decades covered by this analysis include the global financial crisis of the late 2000s but exclude the 2022 war in Ukraine. The stability of world commodity markets led one of the founders of foresighting (Wack, 1985) to observe that forecasts tend to fail when they are needed most – at times of structural change in world markets, for example.

Green *et al*. (2015, p.1768) defined conservative forecasts as those that draw upon, and are consistent with, all relevant and important knowledge about situations and forecasting methods. ABARES conservatism is reinforced by a concern for legitimacy, especially in the way information is shaped and released to serve diverse user groups fairly. As a government forecaster, ABARES is independent of commercial interests in the volatility of specific markets, independent of industry interests in the effect of forecasts on policy outcomes, and independent of methodological preferences that can be characteristic of academic communities.

Taken to extremes, criticisms of forecast accuracy can distract from deeper assessments of the usefulness of forecasts. From time-to-time, the accuracy of ABARES forecasts is criticised from a range of perspectives (see for example Keane (2008) and Condon (2012)). But given the resource trade-offs involved, and the multiple quality dimensions of forecasts, more telling insights are likely to arise from asking how useful forecasts are in supporting decision making. This approach to forecast quality was aphorised by British statistician George Box, who said “All models are wrong, but some are useful” (Box, 1976). Accuracy is not always the most important factor limiting the value of forecasts for decision making, and discovering their true value requires deeper assessment of their value to users in supporting decision making (see for example Turban *et al*. (2005)).

To capture the broader dimensions of forecast quality, ABARES attempts to evaluate the quality of its forecasts from three perspectives with varying degrees of success (see Nelson *et al*., 2022b). These include the accuracy of its forecasts, the efficiency and institutional fit of the system used to generate forecasts, and value of forecasts in supporting decision making by end-users. This combined approach overcomes the resource-contingent limitations of using accuracy as the sole quality parameter of forecasting systems. It is usually possible to improve the accuracy of forecasting systems by increasing the resources committed to forecasting but doing so is likely to encounter diminishing returns in terms of the benefits to supporting decision making (Kingma *et al*., 1980). This is a significant issue globally because public sector forecasting systems in places like Canada (AAFC, 2021), the United States (CFARE, 2013; Schnepf, 2017) and Europe (EC, 2020; OECD-FAO, 2021) are resourced to service complex systems of agricultural support. One practical result of this is that ABARES agricultural forecasting and policy team of around 15 people is far smaller than the 800 staff contributing to agricultural forecasting and policy analysis in the USDA and European Commission.

It is relatively rare for forecasting agencies to provide performance measures alongside published forecasts, particularly for agricultural forecasts (Allen, 1994). The USDA is a notable global leader in providing historical accuracy statistics as part of each monthly WASDE release (USDA, 2021). The International Monetary Fund (IMF) provides a database of their historical macroeconomic forecasts (IMF, 2020). Other forecasters, such as the OECD and FAO do not currently provide routine assessments of forecast accuracy.

Conclusions

In providing users with a facility to independently assess forecast accuracy, ABARES is leading international best practice in the management of public sector agricultural forecasting systems. ABARES has done this work as part of a larger review and renovation of its forecasting methodologies.

At first glance it seems obvious that going to considerable effort to provide users with an online database enabling them to independently explore accuracy in fine detail should provide confidence in the use of ABARES forecasts to support decision making. The results show, for example, that ABARES production forecasts are generally highly accurate, and that these are slightly more accurate than corresponding price or export forecasts. They also show that ABARES forecasts are generally unbiased, but that forecast bias can be a transient issue in markets undergoing structural change.

At second glance though, these results are not entirely satisfying. Even this detailed and transparent analysis of forecast accuracy does little to address deeper and more existential questions such as whether, under what conditions and to what extent forecasts of this kind are useful for supporting decision making? At best, revealing accuracy in the depth that has been done in this paper helps to progress assessments of forecast utility towards a balanced consideration of other, broader quality dimensions. This 'necessary but not sufficient' nature of assessed forecast accuracy suggests that priorities for developing the database described in this paper lie more in enabling it to be routinely updated at low cost rather than in making it more sophisticated. This would help to ensure that forecast accuracy continues to be treated as a fundamental property of ABARES forecasts, while freeing up resources to do more in-depth research into the value of forecasts to support decision making.

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Appendix A. Summary forecast performance statistics

ABARES Forecast performance 2000–01 to 2018–19 for selected price series

Commodity	Series	Unit	Relative Error (a)				Average Error (b)			
			Mar-for next FY	Jun - for next FY	Sept - for current FY	Dec - for current FY	Mar-for next FY	Jun - for next FY	Sept - for current FY	Dec - for current FY
Wheat	APW Pool Return	$/t	15%	17%	8%	5%	45	47	23	16
Wheat	ASW Pool Return	$/t	22%	16%	12%	7%	49	36	27	17
Barley	Feed 1, delivered Geelong	$/t	24%	23%	13%	9%	57	54	31	21
Barley	France feed barley, fob Rouen	US$/t	16%	12%	7%	4%	32	26	13	8
Barley	Gairdner Malt 1, delivered Geelong	$/t	21%	23%	15%	9%	54	58	37	23
Canola	Canada, fob Vancouver	US$/t	2%	8%	2%	1%	10	41	8	7
Canola	Delivered Melbourne, (Nov-Oct MY)	$/t	19%	17%	13%	5%	93	85	68	24
Canola	Delivered Melbourne, (Oct-Sep MY)	$/t	17%	9%	6%	8%	65	37	24	36
Canola	Delivered Melbourne, FY	$/t	6%	6%	3%	2%	35	32	15	12
Cotton	Cotlook A index	USc/lb	16%	15%	11%	8%	12	12	9	7
Sugar	Nearby futures price (Oct–Sep basis), ICE no. 11 contract.	USc/lb	22%	22%	17%	12%	3	3	2	2
Sugar	Return to growers for sugarcane	$/t	16%	13%	13%	10%	5	4	5	3
Maize	US no. 2 yellow corn, fob Gulf	US$/t	15%	15%	10%	5%	27	27	17	8
Soybeans	US no.2 soybeans, fob	US$/t	15%	15%	12%	8%	58	59	48	32
Cattle	Saleyard price, weighted average	c/kg (cw)	10%	8%	5%	4%	33	29	17	12

Commodity	Series	Unit	Relative Error (a)				Average Error (b)			
			Mar-for next FY	Jun - for next FY	Sept - for current FY	Dec - for current FY	Mar-for next FY	Jun - for next FY	Sept - for current FY	Dec - for current FY
Dairy - Butter	Butter	US$/t	24%	23%	19%	11%	719	687	531	347
Dairy - Cheese	Cheese	US$/t	16%	14%	11%	6%	549	493	360	193
Dairy - Raw Milk	Farmgate Milk	c/L	11%	9%	8%	7%	4	4	3	3
Dairy - SMP	Price	US$/t	26%	25%	20%	10%	719	653	514	288
Lamb	Saleyard price, weighted average	c/kg (cw)	14%	13%	9%	6%	55	51	34	24
Sheep	Saleyard price, weighted average	c/kg (cw)	23%	23%	18%	16%	52	53	42	35
Wool	Eastern Market Indicator	c/kg	14%	9%	9%	6%	140	91	84	59
Australian Dollar	Ratio of Australian dollars to US dollar	A$/US$	9%	7%	5%	2%	0.07	0.06	0.04	0.02

(a) Symmetrical mean absolute percentage error. (b) Absolute terms, in original units of series.

Source: Author analysis using ABARES historical agricultural forecast database

ABARES Forecast performance 2000–01 to 2018–19 for selected Australian production series

			Relative Error (a)				Average Error (b)			
Commodity	**Series**	**Unit**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**
Wheat	Production	kt	21%	21%	11%	5%	4,413	4,125	2,184	1,150
Barley	Production	kt	22%	20%	16%	16%	1,723	1,517	1,247	1,245
Canola	Production	kt	27%	23%	17%	19%	613	477	398	415
Cotton	Lint production	kt	33%	24%	16%	14%	169	135	84	75
Sugar	Cane cut for crushing	kt	9%	9%	7%	5%	3,042	3,029	2,375	1,446
Sugar	Sugar (tonnes actual)	kt	7%	7%	7%	3%	321	297	296	136
Dairy - Butter	Butter	kt	8%	11%	9%	7%	10	13	13	10
Dairy - Cheese	Cheese	kt	5%	6%	6%	5%	18	20	20	17
Dairy - Raw Milk	Milk produced	ML	4%	3%	3%	2%	363	350	319	195
Dairy - SMP	Production	kt	13%	12%	12%	9%	28	25	25	19
Lamb	Carcase weight	kt (cw)	7%	6%	5%	4%	27	25	23	16
Wool	Shorn wool	kt	7%	5%	4%	4%	29	22	15	15
Wool	Total wool, greasy equivalent	kt	7%	5%	4%	4%	31	24	17	17
Beef	Carcase weight	kt	6%	6%	4%	3%	136	122	92	72
Dairy - Whole Milk Powder	Production	kt	20%	21%	19%	15%	26	25	23	18
Mutton	Carcase weight	kt (cw)	19%	20%	16%	10%	37	41	33	21
Pigs	Pig meat	kt (cw)	4%	4%	3%	2%	15	15	12	9
Poultry	Poultry meat	kt (cw)	4%	4%	4%	4%	40	39	40	39

(a) Symmetrical mean absolute percentage error. (b) Absolute terms, in original units of series.
Source: Author analysis using ABARES historical agricultural forecast database

ABARES Forecast performance 2000–01 to 2018–19 for selected crop production series, Australian states

			Relative Error (a)				Average Error (b)			
Commodity	**Series**	**Unit**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**	**Mar-for current FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**	**Mar-for current FY**
Wheat - NSW	Production	kt	39%	18%	11%	10%	2,181	986	616	546
Wheat - QLD	Production	kt	29%	15%	10%	10%	323	197	118	128
Wheat - SA	Production	kt	28%	22%	7%	6%	951	750	274	227
Wheat - VIC	Production	kt	36%	29%	9%	10%	916	698	204	239
Wheat - WA	Production	kt	17%	13%	6%	4%	1,300	954	454	329

Note: State level production estimates are first issued in the June quarter so care should be taken when comparing the data shown in this table with national figures in other tables. (a) Symmetrical mean absolute percentage error. (b) Absolute terms, in original units of series.

Source: Author analysis using ABARES historical agricultural forecast database

ABARES Forecast performance 2000–01 to 2018–19 for selected crop area series

			Relative Error (a)				Average Error (b)			
Commodity	**Series**	**Unit**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**
Wheat	Harvested area	'000ha	8%	7%	6%	6%	940	848	748	685
Barley	Harvested area	'000ha	14%	11%	11%	11%	546	443	446	439
Canola	Harvested area	'000ha	22%	19%	19%	18%	427	341	342	327
Cotton	Harvested area	'000ha	35%	25%	18%	6%	104	81	55	20
Sugar	Harvested area	'000ha	5%	6%	6%	6%	21	22	21	21

(a) Symmetrical mean absolute percentage error. (b) Absolute terms, in original units of series.

Source: Author analysis using ABARES historical agricultural forecast database

ABARES Forecast performance 2000–01 to 2018–19 for selected crop area series, Australian states

			Relative Error (a)				Average Error (b)			
Commodity	**Series**	**Unit**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**	**Mar-for current FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**	**Mar-for current FY**
Wheat - NSW	Harvested area	'000ha	13%	12%	11%	9%	445	425	386	336
Wheat - QLD	Harvested area	'000ha	21%	12%	11%	12%	157	89	79	90
Wheat - SA	Harvested area	'000ha	6%	6%	6%	5%	134	128	121	100
Wheat - VIC	Harvested area	'000ha	8%	6%	7%	7%	115	91	102	106
Wheat - WA	Harvested area	'000ha	6%	6%	5%	5%	295	267	244	257

Note: State level area estimates are first issued in the June quarter so care should be taken when comparing the data shown with national figures in other tables.
(a) Symmetrical mean absolute percentage error. (b) Absolute terms, in original units of series.
Source: Author analysis using ABARES historical agricultural forecast database

ABARES Forecast performance 2000–01 to 2018–19 for selected production value series

			Relative Error (a)				Average Error (b)			
Commodity	**Series**	**Unit**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**
Wheat	Gross value	$m	23%	23%	15%	10%	1,284	1,207	800	596
Barley	Gross value	$m	21%	24%	18%	20%	350	398	333	338
Canola	Gross value	$m	32%	25%	22%	23%	338	269	265	268
Cotton	Gross value	$m	36%	24%	17%	17%	418	307	202	217
Total Crops	Gross value. Includes all cereals, legumes, oilseeds, cotton, wine grapes, sugar cane, fruits, nuts, vegetables, nursery, flower and turf, pasture crops and hay.	$m	10%	11%	9%	8%	2,176	2,497	1,969	1,728
Wool	Gross value	$m	17%	14%	13%	8%	487	407	365	208
Pigs	Gross value	$m	11%	7%	6%	5%	108	72	64	55
Poultry	Gross value	$m	8%	9%	9%	7%	143	158	150	129
Total Livestock	Gross value. Includes wool, milk, eggs, honey & beeswax, all slaughtered livestock & live animal exports	$m	8%	6%	5%	4%	1,651	1,184	960	857
Total agriculture	Gross value of all agricultural commodities	$m	7%	7%	6%	6%	2,886	3,029	2,650	2,446

(a) Symmetrical mean absolute percentage error. (b) Absolute terms, in original units of series.

Source: Author analysis using ABARES historical agricultural forecast database

ABARES Forecast performance 2000–01 to 2018–19 for selected animal number series

			Relative Error (a)				Average Error (b)			
Commodity	**Series**	**Unit**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**
Cattle	Beef cattle	million head	5%	4%	3%	3%	1.2	1.1	0.6	0.8
Cattle	Cows in milk and dry	million head	6%	6%	6%	5%	0.1	0.1	0.1	0.1
Cattle	Total cattle (beef and dairy)	million head	4%	5%	3%	3%	1.2	1.3	0.9	0.8
Sheep	Total sheep	million head	8%	7%	6%	5%	7.2	5.7	5.1	4.3
Wool	Sheep shorn	million head	7%	6%	5%	4%	7.3	6.0	4.8	4.2
Pigs	Total pigs	million head	7%	7%	7%	7%	0.2	0.2	0.2	0.2

(a) Symmetrical mean absolute percentage error. (b) Absolute terms, in original units of series.

Source: Author analysis using ABARES historical agricultural forecast database

ABARES Forecast performance 2000–01 to 2019–20 for selected export volume series

			Relative Error (a)				Average Error (b)			
Commodity	**Series**	**Unit**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**
Wheat	Includes grain equivalent of wheat flour	kt	23%	19%	13%	8%	3,479	2,753	1,821	1,139
Barley	Includes grain equivalent of malt	kt	31%	27%	26%	17%	1,616	1,330	1,286	883
Canola	Export volume	kt	38%	27%	22%	20%	625	386	326	320
Cotton	Excludes cotton waste and linters	kt	20%	16%	16%	13%	111	90	82	66
Sugar	Export volume	kt	12%	9%	6%	5%	415	307	221	183
Dairy - Butter	Includes butter concentrate and butter oil, dairy spreads, dry butterfat and ghee all expressed as butter	kt	19%	18%	20%	19%	10	9	11	9
Dairy - Cheese	Export volume	kt	12%	9%	8%	10%	22	17	13	19
Dairy - SMP	Export volume	kt	14%	15%	14%	12%	22	25	23	18
Lamb	Shipped weight	kt (sw)	13%	11%	9%	8%	24	20	17	13
Wool	Total wool, greasy equivalent	kt	9%	8%	8%	6%	48	40	41	28
Beef	Shipped weight	kt	12%	10%	10%	7%	118	102	97	69
Dairy - Whole Milk Powder	Export volume	kt	23%	21%	17%	14%	22	20	16	12
Mutton	Shipped weight	kt (sw)	23%	19%	16%	10%	32	27	23	14

(a) Symmetrical mean absolute percentage error. (b) Absolute terms, in original units of series.
Source: Author analysis using ABARES historical agricultural forecast database

ABARES Forecast performance 2000–01 to 2019–20 for selected export value series

			Relative Error (a)				Average Error (b)			
Commodity	**Series**	**Unit**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**	**Mar-for next FY**	**Jun - for next FY**	**Sept - for current FY**	**Dec - for current FY**
Wheat	Free-on-board value	$m	22%	19%	12%	9%	1,016	864	520	388
Barley	Free-on-board value	$m	25%	28%	27%	22%	377	415	401	332
Canola	Free-on-board value	$m	36%	27%	24%	23%	327	233	217	229
Cotton	Free-on-board value	$m	25%	18%	16%	13%	338	231	184	155
Sugar	Free-on-board value	$m	19%	15%	12%	12%	310	230	183	170
Total Crops	Free-on-board value	$m	11%	9%	7%	5%	2,045	1,671	1,237	882
Dairy - Butter	Free-on-board value	$m	23%	17%	14%	17%	47	31	26	31
Dairy - Cheese	Free-on-board value	$m	16%	9%	7%	10%	143	75	58	82
Dairy - SMP	Free-on-board value	$m	17%	17%	16%	17%	79	89	85	93
Wool	Free-on-board value	$m	12%	11%	8%	7%	372	333	245	215
Beef	Free-on-board value	$m	18%	16%	15%	11%	1,083	901	884	602
Dairy - Whole Milk Powder	Free-on-board value	$m	26%	20%	21%	16%	105	78	83	64
Total Livestock	Free-on-board value	$m	10%	9%	8%	7%	1,773	1,541	1,474	1,159
Total agricultur e	Free-on-board value	$m	8%	7%	6%	5%	2,596	2,595	2,371	1,885

(a) Symmetrical mean absolute percentage error. (b) Absolute terms, in original units of series.
Source: Author analysis using ABARES historical agricultural forecast database