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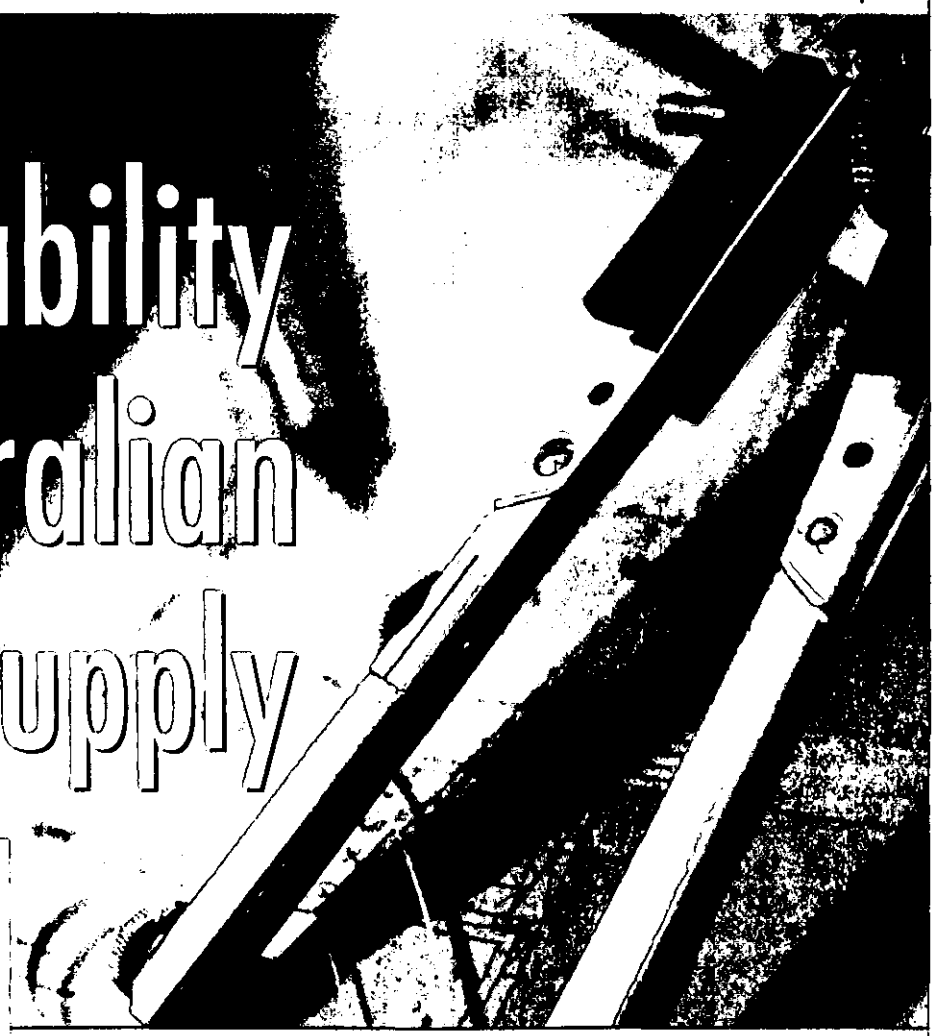
Refereed Research Papers

Predictability of Australian Office Supply



By David Higgins

Abstract

This paper examines how accurate property experts have been in forecasting one and two year office supply. The study covers 12 years of new supply and refurbishment forecasts for Australian state capitals. A range of statistical tests shows that the property expert's forecasts for new supply and refurbished space provided a poor indicator of future office supply. The margin of error suggests that property experts' assumptions on the timing of future supply were imprecise with the trend to overestimate new and refurbished supply, apart for year two refurbishment forecasts, which underestimated future refurbished space. During the office supply cycle, the forecast accuracy varied, with relatively good forecasts for new supply during the oversupply period, compared with high forecast error during the low supply period. A more robust analysis of future supply could be achieved using probability analysis on the timing of new supply, and employing econometric modelling techniques for refurbishment forecasts to link property and space market conditions to office lease expiry profiles.

Introduction

Forecasts are crucial when making major commercial property decisions. This has led to considerable emphasis being placed on understanding property market structure and the relationship with space, capital and property supply market determinants. The changing macroeconomic environment has previously focused property research on space and capital market drivers, as property supply has traditionally been viewed in the short term as being inflexible and within known supply parameters. This needs to be examined further to establish the credentials of property supply forecasts.

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Property supply research is restricted by the availability of data. Measures of property supply have principally focused on the supply pipeline (planning, development and construction phases). In Australia, office supply fore-

casts are published bi-annually in the Property Council of Australia *Australian Office Market Report*. The report covers the main office markets with qualitative research (surveys verified by panels of property experts) providing supply output forecasts detailing by building, expected (one and two years) and mooted new and refurbished office supply. This research is compiled from 12 years of *Australian Office Market Reports* and examines the office supply forecast record for the Australian capital city office market.

The quality of the property supply forecasts needs to be established for accuracy and effectiveness. A measure of accuracy is the forecast "goodness of fit" to actual supply with a comparison to a naive forecast providing a gauge of effectiveness. Combining the information can establish the capability of property experts to provide property supply forecasts. This will assist property decision-makers, especially during different stages of the property cycle.

The remainder of the paper is divided into five sections. Firstly a literature review details the research behind the topic. Secondly a section discusses the forecast supply property data and thirdly the methodology for measuring forecast errors is examined. The results and a conclusion follow.

Literature Review

A large body of property research has examined the way in which the wider economy affects property (for example: London Economics 1998, Ball *et al*, 1998, DiPasquale and Wheaton 1996). Frequently illustrated is the 'cobweb theory', where the dynamic behaviour of the property market is demonstrated with short-term demand changes interacting with long-term supply characteristics.

Similarly, Key *et al* (1994) noted the basic theory underlying property performance is, in essence, very simple: rents are the price resulting from the interaction between total occupier requirement for space and the space available to satisfy demand. The interplay leads to the extent of new supply forming a key determinant when modelling property market performance.

In identifying the importance of property supply data in property market models, Ball and Tsolacos (2002) expressed concern as to the accuracy of the UK government construction data. The issue relates to the way construction data is compiled, with the impact of large projects, the cost indices used to deflate current price data, missing information and the addition of unrecorded output and estimates. Such problems make the construction data relatively poor bases upon which to formulate property market forecasts.

> 'the quality of the property supply forecasts needs to be established for accuracy and effectiveness'

The use of construction data in Australian property market models is shown by the Higgins (2000) survey of 15 Australian organisations that provide property forecasts. The survey, limited by the issues of commercial confidentially, did however show construction activity was a leading forecast determinant in Sydney CBD prime office rent models, and that retrospective analysis of the forecasts and property model inputs was deficient. The absence of a standard approach to accurately measure forecast error restricts the usefulness of the property forecasts.

A common approach in past property research was to accept forecasts based on the property model historical relationship with the actual data series. More recent articles, such as Chaplin (2000), Thompson and Tsolacos (1999) and Wilson *et al* (2000) have provided short-term, out-of-sample (*ex-ante*) forecast accuracy tests which highlighted that a good fit with historical data may have limited predictive powers. Analysis of *ex-ante* forecast error translates into measuring the quality of the forecast method and so provides a valuable tool in the property decision-making process.

The role of judgment in the forecasting process has long been a subject of analysis. Empirical evidence on judgmental forecasts is frequently illustrated using published evidence on specific events (see Makridakis *et al* 1998, DeLurgio 1998). Analysis of judgmental predictions follows the quantitative approach with reference to forecast accuracy tests. The failures of judgmental forecasts are well documented with Makridakis *et al* (1998) providing a table summarising the impacts and sources of judgmental bias.

Property Supply Data

For over 20 years, the Property Council of Australia (and its predecessor, the Building Owners and Managers Association) has compiled a comprehensive inventory of useable office space and projected supply in major Australian office markets. The office stock database includes details of building names and completion dates, quality grades, net lettable areas, ownership and building vacancy on a direct and sub-lease basis. This inventory is used to calculate total office stock, vacancy, supply, withdrawals and absorption.

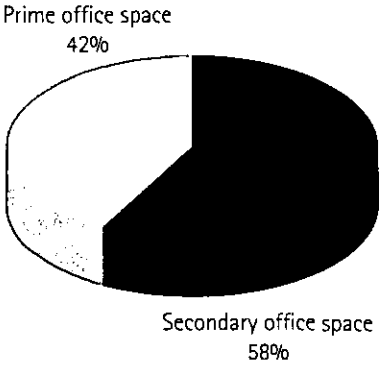
As part of the office inventory, the office stock is graded. The Property Council divides buildings into five quality categories according to size, location, building finishes and technical services. The Property Council of Australia office grades generally correspond with North American (NCREIF) and European (IPD) property index, although the category classifications vary. Market definitions can be supplied by the index providers.

Australian Prime office space relates to Premium and A grade buildings, whereas secondary office space accounts for the remaining B, C and D grade buildings. Prime office space provides the benchmark rental in Australia. Building features include the outlook, largely column-free floorplates, a multi-zoned air conditioning system, security key card access and short waiting intervals for lifts.

This paper analyses the Australian capital city office market. Figure 1 shows the composition and size of the Australian office market at December 2002.

As at December 2002 there were 11.6 million square metres of office stock in Australia's

Figure 1: Australian State Capital Office Market
Total size = 11.6 million square metres



Source: Property Council of Australia 2003

state capital CBDs. More than 200 prime office buildings, totalling 4.9 million square metres, represent the prime office space and account for between 32 and 58 percent of each state's capital office stock.

The composition of state capital office markets limits new supply, as prime office buildings are rarely demolished and redeveloped, while there is a choice for secondary grade office buildings to be either redeveloped, refurbished or to undergo a change of use to residential apartments. This would indicate that while new developments will continue to occur in these office markets, refurbishment will form an important part of the future office supply and is a key component in the office supply cycle.

At the same time as the office inventory survey, the Property Council of Australia collects office supply data. A broad range of information is collated from a survey of owners, developers, agents and architects. Information on new supply and refurbishments includes the development timeline, completion date, lettable areas (office, retail, showroom, etc.), typical floor areas and space precommitments. Once this information has been compiled in a detailed schedule, it is vetted by a committee of industry specialists who collectively review details of each new construction, full refurbishment and partial refurbishment project, and assess the project's expected or mooted viability. Each new and refurbishment project requires a certificate for occupation to verify completion.

The comprehensive office market information in the Property Council of Australia's *Australian Office Market Report* is used extensively and provides a benchmark for the current and likely future condition of the Australian office market. Knowledge of future office supply is a significant tool in commercial property decision making.

Methodology

Forecasts can be examined for both accuracy and effectiveness. Visual analysis together with statistical tests can show any systematic forecast errors which include the number and magnitude of over and underestimates of forecast values; whether the forecasts are improving with time; and if changes in the forecast error is associated with particular phases of the office supply cycle.

> 'forecast accuracy can be measured by how close the forecast values are to actual values'

Similarly, as judgmental forecasts are often characterised by considerable bias and limitations (Makridakis *et al* 1998), the effectiveness of alternative statistical methods needs to be considered and if the accuracy of the judgmental prediction can be improved by using some simply applied statistical model.

Forecast Accuracy

Forecast accuracy can be measured by how close the forecast values are to actual values. The methods to measure forecast accuracy generally embody either the absolute values of the error or the square of the errors, to prevent positive and negative forecast errors cancelling each other out. To evaluate the accuracy of the property performance forecasts, both systems were applied with the Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE) tests. The statistical equations are detailed in the appendix.

When analysing data, Makridakis *et al* (1998) explains there are issues with both statistical equations as with the MAPE test you can get extremely high percentage errors with low actual values. Likewise, as the RMSE test squares the forecast errors, a large data spread could affect the results. Therefore the forecast error data was examined initially for outliers and observations selected within +/- two standard deviations (95%) of the mean.

Forecast Effectiveness

Evaluating forecast models can relate to their effectiveness compared with alternative forecast methods. Comparisons can be to a simple naïve standard or a simple adjustment to the judgment model. The Theil's (1966) *U* coefficient test indicates whether a forecaster's errors are significantly smaller than those of a benchmark. A frequently used naïve standard compares a forecaster's error with those obtained from a no change (random walk) naïve model. In this instance, it is the most recent observation available prior to the forecast period.

Theil's *U* test

$$U = \frac{\text{RMSE of the forecasting model}}{\text{RMSE of the naïve model}}$$

Comparing the RMSE (standard error) of the forecast model values to naïve model values Theil's equation provides a *U* value, which can be summarised as follows:

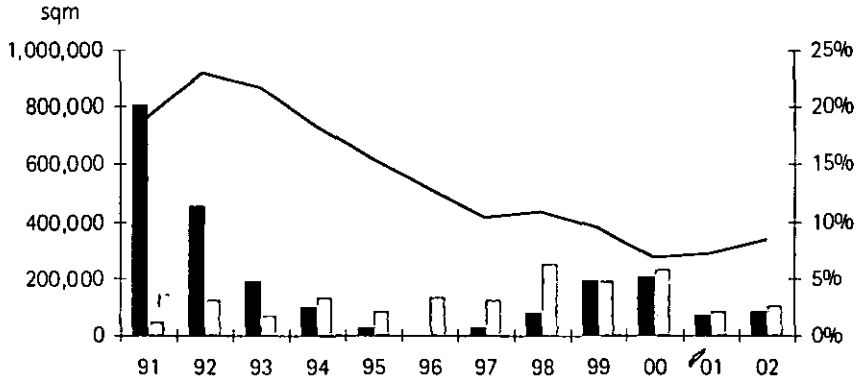
(i) $U = 1$ the naïve model is as good as the forecast model.

(ii) $U < 1$ the forecast model is better than the naïve model.

(iii) $U > 1$ the naïve model is better than the forecast model.

A naïve model can serve as an appropriate minimum standard of comparison, however with large annual supply variations an additional Theil *U* test can relate to the timeliness of the office supply. This examines if the property experts can predict when the office supply will occur. In this case, the forecast error value for each period is applied equally to the previous and next forecast period.

Figure 2: Australian State Capitals—Office Supply 1991–2002



Source: Property Council of Australia 2003

Results

For the 12 years to December 2002, office supply in Australian state capitals expanded by 1.0 percent on average per annum. The low office supply was due to a major downturn in the early 1990s which signalled a more cautious approach for new development with substantial tenant precommitments required. During this period the availability of existing office space placed pressure on property owners to upgrade their buildings to compete and attract tenants. The movements between new and refurbished supply can be compared with vacancy levels. See Figure 2.

Figure 2 shows the structural change in Australian office supply. The oversupply in the early 1990s created an unsustainable 5.2 percent annual increase in the total office stock. The office market down cycle was rapid and by the mid 1990s new office supply was nearly zero. More recently, the fluctuating low office supply growth pattern appears to provide evidence of an efficient marketplace.

Table 1: Australian State Capitals—Office Supply Cycle

	1991-1994		1995-1998		1999-2002	
	sqm	% of total	sqm	% of total	sqm	% of total
New Supply	1,544,300	80%	134,175	18%	553,624	47%
Refurbishments	388,200	20%	608,156	82%	622,719	53%

Table 2: Australian State Capitals New Office Supply Forecasts 1991–2002

Year	Actual	Year One		Year Two	
	New Supply	Forecast	Error	Forecast	Error
1991	807,400	798,205	9,195	920,653	-113,253
1992	452,000	470,200	-18,200	532,729	-80,729
1993	188,600	190,800	-2,200	230,400	-41,800
1994	96,300	170,100	-73,800	96,500	-200
1995	27,200	40,000	-12,800	0	27,200
1996	1,400	29,600	-28,200	0	1,400
1997	25,900	48,000	-22,100	44,700	-18,800
1998	79,675	65,300	14,375	262,500	-182,825
1999	191,888	191,800	88	219,800	-27,912
2000	204,300	249,500	-45,200	203,400	900
2001	70,344	89,540	-19,196	0	70,344
2002	87,092	57,341	29,751	29,785	57,307

The changes in the office supply cycle illustrate the emergence of refurbished space as a source of supply.

The supply of office space relative to property market demand can lead to distinct office supply phases. These occur over periods of years and can be grouped together as in Table 1. The changes in the Australian office market are evident as shown by the emergence of refurbished space in the mid 1990s which provided an attractive alternative to new office supply. The swing between new and refurbished space can affect office supply forecasts. Importantly, refurbishment appears to be less affected by movements in the office cycle as a single floor to the complete building can be refurbished.

The forthcoming office supply should be assessable with a long construction timelines and substantial development costs. In addition there is data on space precommitments and lease expiry profiles of major space occupiers. Information is extensive and should provide the property experts with the tools to extrapolate with some certainty about future office supply.

Table 2 details the Property Council of Australia's one and two year forecasts for new office supply in the Australian state capitals.

Table 2 shows that year one and two forecasts generally overestimated the supply of new office space. For the 12 years, the year one forecasts overestimated for eight years with a mean forecast error of -7.5 percent compared with the year two forecast of seven years with a mean forecast error of -13.8 percent. The forecast error varies between years and there was no evidence of forecast accuracy improving with time, or by combining year one and two forecasts.

However, new supply forecast errors varied during the office supply cycle. Large office supply in the 1991–1993 period yielded a minimal year one mean error of -0.8 percent compared with the high -36.3 percent mean error associated with the low new supply of the 1995–1998 period. This suggests that expert forecasts were biased towards a positive office development outlook during the low new office supply period.

The two year forecasts offered a contrast with a wide range of forecast errors including two forecasts of virtually no error (1994 and 2000).

Table 3: Australian State Capitals Refurbishment Forecasts 1991–2002

Year	Actual	Year One		Year Two	
	Refurbishment	Forecast	Error	Forecast	Error
1991	48,000	50,206	-2,206	109,604	-61,604
1992	139,800	74,800	65,000	67,952	71,848
1993	61,000	45,200	15,800	101,800	-40,800
1994	142,900	129,000	13,900	29,500	113,400
1995	85,400	89,300	-3,900	6,300	79,100
1996	138,200	195,200	-57,000	43,300	94,900
1997	122,100	129,900	-7,800	11,500	110,600
1998	241,233	211,000	30,233	101,300	139,933
1999	156,124	120,600	35,524	27,200	128,924
2000	229,170	244,200	-15,030	28,700	200,470
2001	69,467	95,157	-25,690	0	69,467
2002	83,887	128,597	-44,710	20,509	63,378

The forecast error appears arbitrary, although since 1995, forecasts have exhibited a two- or three-year pattern alternating between positive and negative error. The systematic error can be linked (with some success) to economic conditions at the time of the forecasts. The property experts overestimated the rate of supply during strong economic growth and underestimated it during a slowdown in the economy, even though development timeframes would suggest that new developments should be well into the building construction phase.

Table 3 shows that office refurbishment forecasts have contrasting patterns of forecast error. The year one forecasts overestimated actual supply for seven years with a low, mean error of 0.3 percent. This compared with an underestimation by year two forecasts of 10 years with a high mean error of 63.9 percent. The contrast in the refurbishment forecasts initially suggests that those preparing the forecasts have a good knowledge of current office refurbishment. Beyond the one year period, refurbishment forecasts may need to use an alternative forecasting approach.

The year one refurbishment forecasts seemed to vary depending on the office supply cycle stages: underestimation during oversupply of new office buildings in the early 1990s and from 1995 onward, an overestimation for refurbished office space, except for 1998 and 1999.

More information on the property expert forecasts can be gained from the major features of the forecast error data. Levine *et al* (1999) details the descriptive statistic measures (the variation, shape and central tendency of the data). This is shown in Table 4.

Table 4 highlights the widespread distribution of forecast errors—noticeably the difference in the mean and median—with year two new supply forecasts indicating some unusually high (underestimated) values. The standard deviation and data range were relatively similar for year one and year two new supply and refurbished forecasts.

The skewed measures show the shape of the data distribution. The new supply forecasts and year two refurbishment forecasts are negatively skewed with some unusually high negative values. Year one refurbishment forecasts are close to symmetrical with a slight positive skew from some relatively large positive forecasts errors.

The maximum positive and negative forecast errors appear to be unrelated, as the dates for the major forecast errors in year one did not appear a year later in year two. This would suggest each forecast appeared to be made separately and is unrelated to previous forecasts, with little evidence of back testing.

Table 5 examines the historical accuracy of the new supply and refurbishment forecasts. Preliminary data analysis shows the new supply forecast contained outliers (+/- two standard deviations) in the new supply forecasts (year one: 1994 and year two: 1998). These were excluded from the forecast accuracy and effectiveness test data. Both the MAPE and RMSE test revealed high error readings, which deteriorated from year one to year two forecasts. The contrast between year one refurbishment and new supply results was due, in part, to refurbishment forecast error being in a narrower range but which contained individual values with high forecast error. The extent of the error in new supply and refurbishment forecasts would be of concern to property decision-makers.

Benchmarks based on the Theil *U* value test can provide naïve and forecast error comparisons. The results showed predictably that despite the relatively large forecast errors, property experts can forecast new office forecasts better than a naïve no-change forecast. However the property experts' refurbishment forecasts are less robust with forecast horizons restricted to a year ahead. Beyond one year, a more appropriate approach may need to be considered to forecast refurbished office supply.

Table 4: Descriptive Statistics of the Forecast Error

	New Supply Forecasts		Refurbishment Forecasts	
	Year One	Year Two	Year One	Year Two
Mean	-14,024	-25,697	343	80,801
Standard error	8,005	20,725	9,946	20,937
Median	-15,500	-9,500	-3,053	87,000
Standard deviation	27,729	71,794	34,453	72,528
Skewness	-0.63	-0.90	0.12	-0.74
Range	103,551	253,169	122,000	262,074
Minimum	-73,800	-182,825	-57,000	-61,604
Year of minimum	1994	1998	1996	1993
Maximum	29,751	70,344	65,000	200,470
Year of maximum	2002	2002	1992	2000

Table 5: Forecast Accuracy and Effectiveness Tests

	New Supply Forecasts		Refurbishment Forecasts	
	Year One	Year Two	Year One	Year Two
Forecast Accuracy				
Mean absolute percentage error	29%	67%	23%	82%
Root mean square error	22,098	53,256	32,988	106,540
Forecast Effectiveness				
U Value - Naive forecast	0.21	0.20	0.38	2.36
U Value - Timing Error	0.82	1.58	1.13	1.40

It is less clear if property experts have the ability to correctly gauge the supply timetable. Adjustment to the property expert forecasts based on the surrounding forecast errors provided values similar to superior Theil *U* values. This suggests that property experts have difficulty forecasting projected completion dates. Probability analysis forming part of the judgmental forecast process should improve forecasting performance. This is when forecast supply for a specified time period is close to either the previous or next time period, they a proportion of the forecast supply should be allocated to the adjoining time period.

The forecast accuracy and effectiveness tests demonstrated the limitations of property experts providing office market supply forecasts. The discrepancies in new space and refurbishment forecasts appear unrelated. The lower forecast error in year one new supply forecasts suggests that those preparing the forecasts have a better knowledge of the expected new supply than of refurbishments.

Conclusion

This paper considers the quality of Australian office supply forecasts over the past 12 years. Panels of local property experts provide the regular one and two year new supply and refurbished forecasts in the bi-annual Property Council of Australia's *Australian Office Market Report*. This research examines the Australian state capital cities which, during this period, exhibited distinct office supply cycle phases. The nature of property with long construction time frames and recorded office lease expiry profiles should deliver some certainty for office supply forecasts. In contrast, the forecasts exhibited over time a wide range of forecast errors, which restricts the applications for this data in property market models.

'there is a strong case for improving the forecasting approach'

Overall, the forecast accuracy deteriorated between year one and year two forecasts. The trend was to overestimate new and refurbished supply, apart from year two refurbishment forecasts, which seriously underestimated the future refurbished space. During the office supply cycle, the forecast accuracy varied, with relatively good new supply office forecasts during the oversupply period (1991–1994), compared with high forecast error during the period of low office supply (1995–1998). The year one refurbishment forecasts appeared to rotate on a two- and three-year cycle from over to underestimating the forecast refurbished supply.

Forecast errors appear arbitrary for both new supply and refurbishment forecasts from year one to year two. There is little evidence that forecasts have improved over time, with deficiencies invariably existing in forecasting the timeliness of future office supply.

There is a strong case for improving the forecasting approach, this could be achieved by including probability analysis on the timing of new supply and the employment of econometric modelling techniques for refurbishment forecasts to link property and space market conditions to office lease expiry profiles. An increase in the forecast accuracy record would assist with the challenges in modelling the commercial property markets.

Appendix

(i) Mean absolute percentage error (MAPE)

$$MAPE = \sum_{t=1}^{n} |PE_t| / n$$

(ii) Root mean square error (RMSE)

$$RMSE = \sqrt{\sum e^2_t / (n - 1)}$$

Where: e_t is the forecast error in time period t;

PE_t is the measure of the error to actual ratio in time t;

n is the number of observations in the forecast period.

Source: DeLurgio 1998

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