



Australian Government



Jobs and Skills Australia

# Nowcast of Employment by Region and Occupation 3.0 (NERO v3)

June 2026





All content is provided under a Creative Commons Attribution 4.0 International Licence with the exception of:

- content supplied by third parties
- the Commonwealth Coat of Arms
- material protected by a trade mark
- any images and/or photographs.

Details of the Creative Commons BY 4.0 licence are available on the [Creative Commons website](#).

Use of all or part of any material on this website must include the following attribution:

© Commonwealth of Australia

Terms under which the Commonwealth Coat of Arms can be used are set out on the [Department of the Prime Minister and Cabinet website](#).

### **Attribution**

You may link to this website at your full expense and responsibility. In doing so you must not alter any of the website's contents, frame or reformat the files, pages, images, information and materials from this website on any other website. We reserve the right to prevent linking.

### **Other use**

If you want to use material on this website in a way that is beyond the scope of the terms of use that apply to it, ask us for authorisation. You could infringe our copyright if you use anything on this website in a way that is not permitted or otherwise allowed under the *Copyright Act 1968* (Cth).

Please email [copyright@dewr.gov.au](mailto:copyright@dewr.gov.au) or address requests and enquiries to:

The Copyright Officer  
Department of Employment and Workplace Relations  
GPO Box 9828 Canberra ACT 2601.

### **Acknowledgement of Country**

Jobs and Skills Australia acknowledges the Traditional Owners of Country throughout Australia and recognises the continuing connection to lands, waters and communities. We pay our respect to Aboriginal and Torres Strait Islander cultures, and to Elders past and present.

# Executive summary

The Nowcast of Employment by Region and Occupation (NERO) provides monthly employment estimates by detailed occupation and region categories, complementing other statistics that are often infrequent or highly aggregated. Earlier versions (NERO v1 and NERO v2) showed higher error rates for smaller employment series, limiting estimates' reliability for some regions and occupations.

This paper presents NERO Version 3 (v3), which introduces a targeted structural upgrade to address this limitation. The key changes are the subdivision of series by employment size within Group 1 and the replacement of a linear regression model in the ensemble with a multilayer neural network. These changes address the dynamics across series of different sizes that are not effectively captured by linear specifications.

Using identical training data and an out-of-sample test period of November 2025, NERO v3 reduces Mean Absolute Percentage Error for smaller series from 24.1 to 16.8, while error levels for larger series remain unchanged. The new model achieves materially lower errors, strengthening the foundation of the NERO framework for policy-relevant regional labour market analysis.

# 1. Introduction

The Nowcast of Employment by Region and Occupation (NERO) was developed by Jobs and Skills Australia (JSA) to address the lack of timely, detailed data for employment by occupation and region in Australia's labour market. Official statistics provide high-quality benchmarks, but are often released infrequently, available only at aggregated levels, or subject to volatility when disaggregated. NERO complements these sources by producing a monthly, granular nowcast of employment that supports policy analysis, regional monitoring and other related analytical uses.

NERO Version 1 (v1) established the foundation of the nowcasting framework by combining multiple traditional and near-real-time data sources such as the Australian Bureau of Statistics (ABS) Labour Force Survey, the 2016 Census and JSA's Internet Vacancy Index, within a machine learning ensemble model. NERO Version 2 (v2), released on 5 April 2023, improved performance by incorporating additional data sources and refinements to feature engineering and model training. New inputs included the 2021 Census employment data, ABS Counts of Australian Business, including Entries and Exits, National Centre for Vocational Education Research (NCVER) vocational education and training (VET) enrolments and completions, and experimental regional income and expenditure measures. These enhancements strengthened the empirical foundation of the model and reduced Mean Absolute Percentage Error (MAPE) relative to NERO v1 across most series.

However, the performance of both NERO v1 and NERO v2 was strongly driven by series size, with smaller employment series exhibiting higher errors and greater instability than larger series. This pattern was observed across model types, training and test windows, occupations, and regions. This universality indicates a structural issue rather than a data or model-tuning problem. Over time, these limitations have become more consequential, constraining further accuracy gains and increasing the operational effort required to manage model stability and interpretability.

This paper presents NERO Version 3 (v3). NERO v3 addresses these issues through a fundamental change in the architecture and training strategy. Group 1 series are further subdivided into mutually exclusive subgroups based on their recent average series size. This additional grouping strategy enables more effective handling of groups of different sizes, as series of varying sizes exhibit systematically different behaviour. The linear model used in earlier versions has been replaced with a multilayer neural network, enabling more flexible modelling of non-linear relationships and heterogeneous data behaviour.

NERO v3 was trained using approximately 10 years of Labour Force Survey data up to August 2025, with November 2025 reserved as an out-of-sample test period. For a fair comparison, the current NERO v2 model was retrained using the same data. When both models were evaluated on the same test data, NERO v3 reduced MAPE for the smaller series group from 24.1 to 16.8, a reduction of approximately 30 per cent. These results demonstrate that NERO v3 represents a step change in capability, providing a more robust and scalable foundation for the future development of NERO.

## 2. Evolution of NERO v1 and v2

### 2.1 Architecture and data framework

NERO v1 and v2 share the same underlying architecture, with v2 extending the original framework through the inclusion of additional data sources, refreshed data vintages and refinements to feature engineering and model training. Both versions were designed around a multi-source data strategy that integrates official statistics with alternative, higher-frequency indicators. Core inputs include the Labour Force Survey, 2016 Census employment benchmarks and online job advertisement data. NERO v2 expanded coverage to include 2021 Census employment data, ABS Counts of Australian Business, including Entries and Exits, NCVET enrolments and completions, and experimental regional income and expenditure measures.

Both versions rely on a stacked ensemble architecture. Multiple lower-layer models, including linear regression, random forest and gradient boosting trees are trained on engineered features derived from input datasets. Predictions are then combined through a linear stacking model that produces the final employment estimates. This structure balances flexibility and interpretability while leveraging the strengths of different modelling techniques. Post-model processing plays an important role in both versions. Outputs are subjected to outlier handling, smoothing and reconciliation procedures to ensure coherence with known aggregate trends. Estimates are scaled to align with published Labour Force Survey totals by region and occupation, with smoothing applied to improve stability and usability for analytical purposes.

NERO v1 and v2 delivered several important contributions. The estimates provided a timely and consistent monthly view of employment by detailed occupation and region that was not otherwise available. The product remained broadly consistent with ABS benchmarks, operating as a complementary analytical tool rather than a replacement for official statistics. During periods of relative stability, both versions demonstrated solid performance on average, with acceptable error rates given the scale and complexity of the task. These characteristics supported early adoption and growing reliance on NERO outputs across analytical and policy contexts.

### 2.2 Limitations and performance constraints

Extensive evaluation of NERO v1 and v2 across data vintages, feature sets and modelling refinements identified opportunities for improvement. The most prominent limitation was a strong sensitivity to series size. Smaller employment series, typically those with fewer than 800 workers, consistently exhibited higher error rates and greater volatility than larger series, across both training and testing windows. This behaviour was observed regardless of occupation group or geographic location, indicating fundamental differences in data structure rather than sector or regional effects.

These issues were particularly evident during periods of volatility or structural change. While NERO v1 and v2 were able to track broad labour market movements, they struggled to generalise reliably for smaller series when conditions shifted, with errors increasing in out-of-time tests. Early evaluation showed that variation in MAPE was more strongly associated with series size than with the number of training observations. This finding highlighted a mismatch between the global modelling approach and the underlying data distributions.

Although additional features and further parameter tuning in v2 reduced average MAPE, these refinements did not fully address the persistent underperformance observed in specific subsets of series.

## 3. NERO v3 methodology

The primary goal of NERO v3 was to address the observed limitations of NERO v1 and v2 and to further improve accuracy and robustness. Specifically, NERO v3 sought to improve performance for smaller and more volatile series without degrading performance for larger, more stable series.

### 3.1 Series grouping strategy

As in NERO v1 and v2, series are assigned to one of two groups, with each group modelled separately. Group 1 models were trained using ABS Labour Force Survey custom data on occupational employment by region, while Group 2 models were trained using Census data from 2016 and 2021. This grouping reflects differences in data availability and underpins the overall modelling strategy. Series are typically assigned to Group 2 when corresponding information is not available or is insufficient in the Labour Force Survey.

In NERO v3, development is focused on Group 1 series, which are further subdivided into mutually exclusive subgroups based on their recent average series size. This additional grouping step targets the systematically different behaviour observed across series of different sizes. Series with fewer than 800 workers consistently exhibited higher error rates in both NERO v1 and v2. Training separate models for these subgroups, using the cut-off of 800, allows the model architecture to capture these differences more effectively.

### 3.2 Model architecture and structural changes

NERO v3 maintains the same core nowcasting pipeline and stacked ensemble architecture as earlier versions. This includes target construction, feature generation, occupation and region modelling, and monthly employment estimation. The key architectural change in NERO v3 occurs within the lower-level ensemble. In NERO v1 and v2, the lower-level ensemble consisted of three base learners: a linear regression model, a gradient boosting tree model and a random forest. The linear regression model consistently underperformed compared with the other models, particularly for smaller and more volatile series, and contributed disproportionately to downstream error.

In NERO v3, this linear base learner is replaced by a multilayer neural network. The neural network is trained on the same feature set and serves the same role within the ensemble architecture. However, it provides greater capacity to capture non-linear relationships and complex interactions than the linear specification.

# 4. Model evaluation and results

## 4.1 Comparison scope

In NERO v1 and v2, all Group 1 series were modelled using a unified structure. In NERO v3, Group 1 is subdivided into two mutually exclusive subgroups based on recent average series size, resulting in two model streams (m1 and m2). Group 2 series are modelled identically across all versions and are therefore excluded from this comparison.

## 4.2 Training and evaluation design

To control comparisons, both NERO v3 and v2 were trained using the same data window and evaluated on the same out-of-sample period. Training data consisted of ABS Labour Force Survey custom data on employment by region and occupation, spanning all available observations up to August 2025. The evaluation dataset was November 2025, which was held out from training and used for performance assessment.

Two data sources used in earlier development were excluded from this comparison: the Westpac income and expenditure dataset and the Australian Tax Office Single Touch Payroll data. These datasets were unavailable for the full retraining window and were therefore omitted. All remaining feature inputs were constructed consistently across versions.

## 4.3 Results

Performance is evaluated using MAPE against the November 2025 evaluation dataset. Results are reported separately for both Group 1 subgroups (m1 and m2) from NERO v3 and compared against the corresponding v2 estimates in Table 1.

Table 1

Subgroup	Description	MAPE	
		NERO v2	NERO v3
m1	Smaller, more volatile series < 800	24.1	16.8
m2	Larger, more stable series >= 800	19.3	19.0

For the smaller employment series (m1 subgroup), the v3 model records a MAPE of 16.8, compared with 24.1 for NERO v2, representing an error reduction of approximately 30 per cent. This substantial improvement confirms that the combination of subgrouping and a neural network model addresses the persistent underperformance observed for smaller series in NERO v1 and v2.

For the larger and more stable employment series (m2 subgroup) performance differences are modest, with MAPE declining slightly from 19.3 in v2 to 19.0 in v3. Error levels for larger series are preserved rather than sacrificed to achieve gains in the m1 subgroup.

## 4.4 Interpretation of results

These results confirm that NERO v3 achieves its design objectives. The largest reductions in MAPE occur in the subset of series that historically exhibited the highest errors and volatility. The decision to explicitly model size-related heterogeneity rather than treating it as noise is justified. Error levels for larger series remain effectively unchanged, indicating that gains for smaller series are not achieved through reweighting or implicit trade-offs. Instead, the improvements reflect better alignment between model capacity and data behaviour within each subgroup.

## 4.5 Structural implications

Although the overall ensemble framework is preserved, NERO v3 introduces a structural change that addresses a key limitation of NERO v1 and v2: the inductive capacity of the lower-level learners. Earlier versions embedded a linear regression model as a core learner, missing the opportunity to accommodate nonlinear dynamics, scale effects, and volatility inherent in many employment series.

Replacing this linear component with a multilayer neural network fundamentally changes the class of relationships the ensemble can learn. The neural network increases the flexibility of the lower-level ensemble, which enables it to model non-linear responses and interaction effects within the existing feature set rather than relying on post-model smoothing or reconciliation to mitigate misfit. Crucially, this change is isolated to the weakest element of the ensemble: the remaining base learners, stacking mechanism and reconciliation framework are unchanged, ensuring continuity in model behaviour and interpretability.

In combination with explicit subgrouping of Group 1 series by size, this approach allows the model to internalise heterogeneity across series within the learning process itself. Differences that previously manifested as persistent residual error are instead handled through architecture and training design, without fragmenting the modelling pipeline or introducing additional layers of post-processing.

In short, these changes represent a targeted but substantive upgrade to NERO's modelling core. By aligning model capacity more closely with data behaviour, NERO v3 strengthens the ability of the ensemble to generalise across heterogeneous series while preserving the coherence, transparency and operational simplicity of the existing framework.

## 5. Conclusion

NERO v3 introduces a targeted structural upgrade that aligns model capacity more closely with observed heterogeneity in employment series. By embedding series size into the modelling architecture and strengthening the weakest component of the ensemble, NERO v3 significantly reduces error for smaller series without increasing complexity or destabilising larger ones. This provides a more scalable foundation for future enhancements, including more responsive nowcasting and further data integration.