Quarterly Employment Survey Confidence Intervals User Guidance

The headline estimate of employee jobs is presented alongside a **confidence interval** and a statement of whether the change in the number of employee jobs is **statistically significant.**

This short guide explains the two concepts and how you can use the information to better understand estimated changes in employee jobs.

The final section is for more technical users and provides detailed information on how the confidence intervals are calculated for the Quarterly Employment Survey.

1. Confidence Intervals for Survey Estimates

The Quarterly Employment Survey (QES) is a sample survey. It provides *estimates* of population values (the number of employee jobs in NI). The difference between an estimate from a sample and the (unknown) population value is the result of “sampling errors” and “non-sampling errors”.

- Sampling errors are due to only using a sample and not the entire population, therefore estimates from samples may not equal the unknown population value. The larger the sample, the smaller the sampling error. Confidence intervals are one way of providing information on sampling error.
- Non-sampling errors are due to aspects of surveys other than the sampling, such as businesses being unreachable or refusing to respond to a survey, issues in the questionnaire design, inaccurate answers from respondents, processing and analysis errors. These types of errors would be present in the statistics even if the entire population was surveyed and can be difficult to quantify using the sample data alone.

We provide information on sampling error through **confidence intervals**. Confidence intervals are a standard way of expressing the statistical accuracy of survey based estimates. Typically 90%, 95% or 99% confidence intervals are used. The QES bulletin includes **95%** confidence intervals around headline estimates. If a large number of random samples were taken, the 95% confidence intervals of the resulting employee jobs estimates would contain the population value 95% of the time. The estimate and the 95% confidence interval are presented as follows:

Estimate +/- confidence interval

The larger the sampling error, the larger the corresponding confidence interval.

Example

The seasonally adjusted employee jobs estimate for NI in Q3 2018 was 765,880; with a confidence interval of +/- 6,700 (0.4%).

This means that the best estimate of employee jobs was 765,880. The confidence interval shows the precision of the estimate. At +/- 6,700 or 0.4%, the confidence interval is relatively small, meaning the estimate is relatively precise. In 95 out of 100 samples the true population value would lie within the 95% confidence interval, in this case between 759,180 and 772,580.

2. Confidence Intervals for Assessing Statistical Change

Another important use of confidence intervals is to make a statement about whether there is a statistically significant difference between two estimates. Statistical significance helps us distinguish what observed changes or relationships in data we should pay attention to, and which are likely to be down to chance alone.

For example, say the number of employee jobs in Q4 2017 and Q4 2018 is estimated and corresponding confidence intervals calculated. We can use this information in a simple way to determine whether a statistically significant change has occurred in the estimated number of employee jobs over the year.

If the confidence intervals of these two estimates do not overlap then there is a statistically significant difference between the two estimates.

In the majority of cases, overlapping confidence intervals indicate that there is no significant difference between estimates. A more exact approach is to calculate the ratio of the two estimates, or calculate the difference between them, and then produce a corresponding confidence interval for this difference, however the method of checking for any overlap is a sufficient approximation for most purposes.

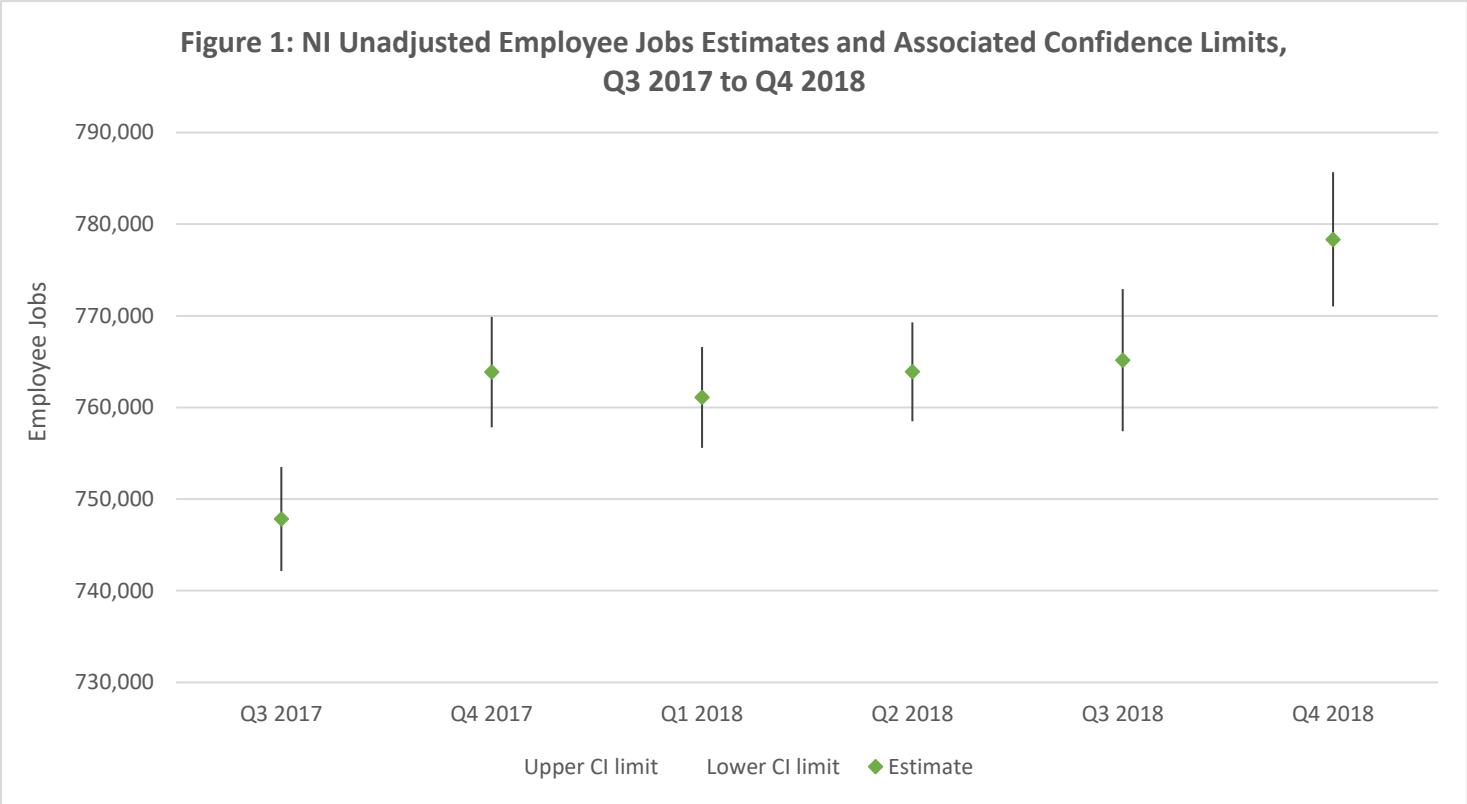
Example

The first bullet point in the Q3 2018 publication reads:

> *The total number of seasonally adjusted employee jobs were estimated at 765,880, an increase of 2,240 jobs over the quarter and 14,700 jobs over the year in September 2018. The annual change in employee jobs is statistically significant i.e. the recorded change exceeded the variability expected from a survey of this size and was likely to reflect real change.*

In the example above, the annual change was statistically significant. By this we mean that the size of the annual change was large enough that it was unlikely to have resulted only from the variable nature of samples.

The graph below shows employee jobs estimates and their corresponding confidence intervals for Q3 2017 to Q4 2018.



First, consider the estimates for Q4 2017 and Q4 2018. What can be said about the change over the year?

The confidence intervals for Q4 2017 and Q4 2018 do not overlap. We can therefore determine that the increase in the employee jobs estimate over the year is statistically significant and likely to reflect real change.

Now consider the estimates for Q2 2018 and Q3 2018. What can be said about the change over the quarter?

Whilst there has also been an increase in the point estimate for the number of employee jobs over this time period, the confidence intervals for the two estimates overlap. We therefore cannot say that this quarterly change in employee jobs estimates is statistically significant. This means that this change could have resulted only from the variable nature of samples.

3. Sampling information and calculating confidence intervals (*for more technical users)*

The QES covers all public sector bodies, all private sector firms with 25 or more employees and a sample of the remainder. The quarterly survey covers all industrial sections apart from agriculture. Employee estimates for the agricultural sector are provided, on an annual basis from the Department of Agriculture, Environment and Rural Affairs (DAERA) Farm Census which surveys all farms.

The QES sample is drawn from the Inter-Departmental Business Register (IDBR).The number of businesses selected varies by size of business and industry sector. The size and industry groups are referred to as strata. An overview of the sample is below:

Employment Size/Sector	
0-9 employees	Sample (4%)
10-24 employees	Sample (9%)
Multiple Industry Activities	Full Count (100%)
25+ employees	Full Count (100%)
Public Sector	Full Count (100%)

The sample survey information is grossed to population totals using ratio estimation.

The following formula is used to calculate the QES confidence intervals:

$$\mathrm{Var(returned\ employees)} = \mathrm{N_h^2}(1 - \frac{\mathrm{n_h}}{\mathrm{N_h}})\frac{1}{\mathrm{n_h}}\mathrm{s_h^2}$$

where

$$\mathrm{s_h^2} = \sum_{\mathrm{i}\epsilon\mathrm{h}}^{\mathrm{n}} \frac{(\mathrm{returned\ employees_i} - \mathrm{R_h frozen\ employees_i})^2}{\mathrm{n_h} - 1} \quad \mathrm{and} \quad \mathrm{R_h} = \frac{\overline{\mathrm{y_h}}}{\overline{\mathrm{x_h}}}$$

N is the number of businesses in the population (from the IDBR sample frame)

n is the number of businesses in the survey sample

h is the strata (for example '0-9' employees in manufacturing)

$\overline{\mathbf{y_h}}$ is the strata mean of returned employees ('returned' refers to employees as reported in returned survey forms)

$\overline{\mathbf{x_h}}$ is the strata mean of employees as recorded on IDBR

Var is the variance (measures the spread of the data)