



Office of the  
Merit Commissioner

2018/19

Report on the Sampling  
Methodology and Extrapolations  
for the Merit Performance Audit

UPHOLDING FAIR HIRING IN THE  
BC PUBLIC SERVICE

March 2020



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## Background

The Merit Commissioner is responsible for performing random audits of BC Public Service appointments to monitor the application of the merit principle under section 8 of the *Public Service Act* (the *Act*). The audits assess whether recruitment and selection practices have resulted in appointments based on merit, and whether individuals possessed the required qualifications for the position to which they were appointed. The results of the audits are reported to organization heads and the Deputy Minister of the BC Public Service Agency (Agency Head). The overall results and analysis of findings are summarized in the *2018/19 Merit Performance Audit Report*, which is provided to the Legislative Assembly and published on the Office of the Merit Commissioner's (the Office) website. The purpose of this report is to provide information on the population of appointments, sampling methodology, and method of extrapolation underpinning the 2018/19 Merit Performance Audit.

## Appointment Population

The 2018/19 audit included appointments made from April 1, 2018, to March 31, 2019. The types of appointments eligible for audit included permanent appointments and temporary appointments of more than seven months. In order to run an efficient audit and provide timely feedback, the Office divided the year into four intervals:

- April 1 – June 30, 2018;
- July 1 – September 30, 2018;
- October 1 – December 31, 2018; and
- January 1 – March 31, 2019.

Lists of appointments made for organizations identified in Appendix A of the *2018/19 Merit Performance Audit Report*, were obtained from the BC Public Service Agency (Agency) from the Corporate Human Resource Information and Payroll System (CHIPS), and from the BC Liquor Distribution Branch (LDB), which retains appointment details independently. The appointment population lists were requested a few days after the end of each interval, which may have resulted in some appointments being missed due to the timing of when relevant information was added to the systems.

Prior to selecting each sample, the Office reviewed the interval appointment population lists to identify duplicate appointments. These entries were investigated by the Office to determine whether they represented unique and eligible appointments for the audit. Any appointments deemed ineligible or duplicate entries were removed from the population list. For each sampling interval, the lists from the Agency and the LDB were combined to form a single appointment population list from which the sample could be drawn. At the end of the fiscal year, a total population of 7,556 appointments was identified.



## Sample Selection

The objective of the merit performance audit is to randomly sample permanent appointments and temporary appointments greater than seven months in order to ascertain the state of merit-based hiring in the BC Public Service. A simple random sample is a statistically representative sample of the population of appointments from which results can be generalized to the total population of appointments<sup>1</sup>. For an overview of how the sample compares to the population of appointments, see the section titled “Distribution of Audits”.

For each interval, the Office used a random number generator to randomize the appointments for selection of the sample. The final sample is representative of the population of appointments, and the final weighted estimates in Table 7 may be generalized to all permanent appointments and temporary appointments over seven months that came into effect between April 1, 2018, and March 31, 2019.

A fixed sample size approach was adopted in 2016/17 to ensure the desired precision would be met for the projected estimated findings, regardless of the size of the population of appointments, and to better meet operational demands. The degree of precision for the confidence level and margin of error for the confidence interval were set to a maximum of 95 per cent and  $\pm 6$  per cent, respectively, for the “merit not applied” finding. When this single proportion is estimated at the conservative value of 50 per cent and the maximum population of appointments is not expected to exceed 10,000, it can then be determined that the largest sample size the Office would require to meet these criteria is 260. Given an increase in the rate of out-of-scope appointments from 4.1 per cent to 6.2 per cent in the 2017/18 audit, the Office selected a total sample size of 280, with a sample of 70 selected at each sampling interval, to provide a buffer to a potentially increasing rate of out-of-scope appointments of up to 7.1 per cent.

The Office drew simple random samples for the first two intervals. An anomaly was then discovered in the population list obtained from the Agency for the first interval, and was confirmed in a corrected interval population list that all “new” employees (n=578) had been erroneously excluded. Given the recruitment and process finding has varied between “existing” and “new” employees, this resulted in a potentially biased sample that needed to be corrected.

To correct for the systematic bias, the proportions of “new” and “existing” employees were compared across intervals from 2016/17, 2017/18, and the first two intervals of 2018/19. The proportions were found to be consistent and a new stratified sampling plan for the last two intervals of 2018/19 was put in place that would result in more closely approximating the actual proportions of “new” and “existing” employees in the current fiscal year. To ensure this correction would be successful and that results could be generalized to the missing “new” employee appointments, the same data was also compared to

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<sup>1</sup> See section titled “Estimates and Confidence Intervals” for more details about the precision of results from this audit.



verify that “new” employees did not vary across quarters (i.e., that process finding, union status, in/out of service competition, type of appointment, job group, and organization size, did not vary across quarters for “new” employees).

To obtain the expected proportions for the corrected population, each of the latter two intervals were stratified as follows: appointments from the LDB as these were unaffected by the error, “new” employees from the Agency list who would be over sampled to compensate for the error, and “existing” employees from the Agency list who would then be under sampled. Table 1 shows the number and proportions of “new” employees and “existing” employees in the broader public service, and all employees for LDB appointments, in the total population list used to draw the samples, the corrected population list (it includes the 581 “new” employees that were originally missed), and the total sample selected. As the sample proportions more closely approximate the corrected proportions, the sample bias has been removed and results can be safely generalized.

Appointment type	Total population of appointments (N=7,556)	Corrected population of appointments (N=8,137)	Total sample of appointments (n=280)
New employees (All except LDB)	1,490 (19.7%)	2,071 (25.5%)	71 (25.4%)
Existing employees (All except LDB)	5,640 (74.6%)	5,640 (69.3%)	194 (69.3%)
LDB (new and existing employees)	426 (5.6%)	426 (5.2%)	15 (5.4%)

In addition, since each quarter included a different number of appointments, this resulted in a different proportion of each interval being represented in the overall sample. Table 2 summarizes the four independent samples drawn during the 2018/19 fiscal year period for auditing, as well as the proportion sampled in each interval.

Sampling interval	Population	Sample size	Proportion sampled
Apr 1 – Jun 30, 2018	1,583	70	4.4%
Jul 1 – Sep 30, 2018	2,124	70	3.3%
Oct 1 – Dec 31, 2018	1,918	70	3.6%
Jan 1 – Mar 31, 2019	1,931	70	3.6%
<b>Total</b>	<b>7,556</b>	<b>280</b>	<b>3.7%</b>



A final post-stratification weighting adjustment was applied to ensure that any bias introduced by disproportionate sampling was minimized in the final population estimates, resulting in the creation of eight unique weights to adjust for bias in the overall sample.

Of the 280 randomly-sampled appointments, the Office identified seven out-of-scope appointments (2.5 per cent of the overall sample), primarily due to coding errors in the source data. This represents a decrease in the rate of out-of-scope appointments. These seven appointments were removed from the sample, leaving 273 in-scope appointments which were subsequently audited. The Office used the strata information to estimate back into the original population how many appointments would likely be found to be out-of-scope if the entire population of appointments was audited. The resulting adjusted in-scope population of 7,363 is shown in Table 3 along with the in-scope populations, sample totals of appointments, and proportions of the population sampled, across audit years since 2011. The statistics presented in the last two sections of this report are based on the in-scope population.

**Table 3: Year-Over-Year Comparison of In-Scope Population and Sample Size**

Year	Number of appointments	Number of audits	Proportion of population sampled <sup>1</sup>
2011	3,942	222	5.6%
2012	3,928	256	5.8%
Fiscal 2013/14 <sup>2</sup>	2,010	150	7.5%
Fiscal 2014/15	3,915	243	6.2%
Fiscal 2015/16	5,343	321	6.0%
Fiscal 2016/17	5,685	257	4.5%
Fiscal 2017/18	6,269	259	4.1%
Fiscal 2018/19	7,363	273	3.7%

**Notes:**

- 1: Prior to 2016/17, a sampling rate was applied to the population as the method of obtaining a sample. The respective values for these years represent the resulting sampling rate for the audit cycle. For the 2016/17, 2017/18, and 2018/19 audits, a fixed sample size approach was used to achieve a 95 per cent confidence level and  $\pm 6$  per cent margin of error for the “merit not applied” finding. The respective values for these years represent the proportion of the population that was audited.
- 2: In 2013/14, the audit period was changed to a fiscal year audit. This transition resulted in a seven-month audit period of appointments from September 1, 2013 to March 31, 2014.

## Distribution of Audits

Tables 4, 5, and 6 show how the in-scope appointments selected for audit are distributed in the sample compared to the total population of appointments from the BC Public Service used for sampling, by appointment type and organization size. The sample is also compared to the same population by job classification group, as this illustrates another way in which the sample is representative of the population of appointments from which it was drawn.



The small difference in values ( $\pm 5$  per cent) between the sample and population percentages indicates that even though the sample itself was not stratified based on these variables, the 2018/19 sample is proportionately representative of the total population of appointments for the same period for the appointment types, organization sizes, and job classification groups shown below. Tables 4, 5, and 6 represent actual values found in the sample and population, without the seven out-of-scope appointments.<sup>2</sup>

**Table 4: Audits by Appointment Type**

Appointment type	Total number of appointments	Per cent of all appointments	Number of audits	Per cent of all audits
Permanent	7,000	92.7%	255	93.4%
Temporary over 7 months	549	7.3%	18	6.6%

**Table 5: Audits by Organization Size**

Organization size	Total number of appointments	Per cent of all appointments	Number of audits	Per cent of all audits
Large (> 1,000 employees)	6,284	83.2%	228	83.5%
Small ( $\leq$ 1,000 employees)	1,265	16.8%	45	16.5%

**Table 6: Audits by Job Classification Group**

Job classification group	Total number of appointments	Per cent of all appointments	Number of audits	Per cent of all audits
Administrative support	1,668	22.1%	62	22.7%
Enforcement & corrections	381	5.0%	10	3.7%
Finance & economics	354	4.7%	12	4.4%
Health, education & social work	858	11.4%	45	16.5%
Information technology	354	4.7%	12	4.4%
Legal counsel	98	1.3%	3	1.1%
Management band & executive	1,373	18.2%	47	17.2%
Science & technical officers	655	8.7%	23	8.4%
Senior administration & research	1,691	22.4%	54	19.8%
Trades & operations	117	1.5%	5	1.8%

<sup>2</sup> It is not possible to obtain adjusted in-scope population estimates by these characteristics because the sample was not stratified by these characteristics.



## Estimates and Confidence Intervals

The Office applied confidence intervals to the estimates for the 2018/19 audit, basing them on a Poisson distribution appropriate for generating estimates for rare events. This practice has been in place since the 2010 Merit Performance Audit. For the purposes of the 2018/19 Merit Performance Audit, a rare event would be interpreted as findings that occur infrequently, such as the “merit not applied” finding.

Even though the sampling variation across each sampling interval was small, the micro-data was weighted prior to generating the population estimates and confidence intervals in order to both minimize sample bias and to produce the best estimates.

A 95 per cent confidence interval can be interpreted as: with repeated sampling, the true population parameter would be found within the upper and lower limits of that interval 95 times out of 100. Therefore, in Table 7, the true population value for each of the “merit not applied”, “merit with exception”, and “merit” findings will lie within the lower and upper limits of the respective confidence intervals 95 times out of 100.

Audit	Audit finding	Sample appointments audited	Estimate (weighted)	95% Confidence interval	
				Lower	Upper
2018/19 Audit	Merit not applied	3.3%	2.9%	1.1%	5.0%
	Merit with exception	41.0%	41.4%	33.9%	49.2%
	Merit applied	55.7%	55.7%	47.2%	64.9%

In the 2018/19 audit, the extrapolated estimates suggest that appointments with a “merit not applied” finding make up 2.9 per cent of all appointments; however, the true proportion of appointments with a “merit not applied” finding may lie as low as 1.1 per cent and as high as 5.0 per cent in the total population. The margin of error for this finding is smaller (i.e., more precise) than the set precision level of  $\pm 6$  per cent, at approximately  $\pm 2$  per cent. The true proportion of appointments with a “merit with exception” finding may lie as low as 33.9 per cent and as high as 49.2 per cent. The true proportion of appointments with a “merit” finding may lie as low as 47.2 per cent and as high as 64.9 per cent.

As in the two previous fiscal year audits, the weighted estimates for the audit findings in Table 7 are very similar to the sample findings, suggesting there was very little bias introduced into the sample as a result of the sampling methodology.





## Uses and Limitations of Audit Results

There is always some error and uncertainty associated with sampling, as well as in any resulting statistics. This expectation of error is shown through the application of the confidence interval (here 95 per cent) around statistics of interest. This provides a level of precision associated with a sampling method as a percentage range both above and below the estimated statistic.

As a sample size increases, the likelihood of variance (or variability within a sample) decreases, and so does the error associated with the sampling. Samples should always aim to achieve the lowest possible ranges on those statistics and as such, the confidence in being able to say a sample represents the true population of appointments must be considered with the results of the confidence intervals in mind.

The appointments selected for audit are a random sample from a list of appointments occurring between April 1, 2018, and March 31, 2019. In terms of year-over-year comparisons, the number of audits conducted in the 2018/19 fiscal year (273) was similar to that in 2017/18 (259) due to the fixed sample size approach now used. Due to year-over-year changes in sampling approach, caution should be used when comparing results to previous years. This particularly applies when comparing 2016/17 and 2017/18 results to prior merit performance audits, as well as each other, due to the modifications that were introduced for the 2016/17 and 2017/18 audits. (Refer to the reports *Merit Performance Audit 2016/17* and *Merit Performance Audit 2017/18* for more details on the modifications.)



Table 8 summarizes changes made since 2011 to the sampling and audit approach.

Table 8: Sampling and Audit Approach Changes											
Year	Appointment types audited			Strata							Audit finding changes
	Permanent	Temporary over 7 months	Direct	Organization database <sup>1</sup>	Sampling interval	Administrative status	Organization size	Appointment type	Bargaining unit status	Employee status	
2011 <sup>2</sup>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2012	✓	✓	✓	✓	✓	✓	✓	✓	✓		
2013/14 <sup>3</sup>	✓	✓	✓	✓	✓		✓	✓			
2014/15 <sup>4</sup>	✓	✓	✓	✓	✓		✓	✓			
2015/16 <sup>5</sup>	✓	✓			✓			✓			
2016/17 <sup>6</sup>	✓	✓			✓						✓
2017/18 <sup>7</sup>	✓	✓			✓						✓
2018/19 <sup>8</sup>	✓	✓		✓	✓					✓	

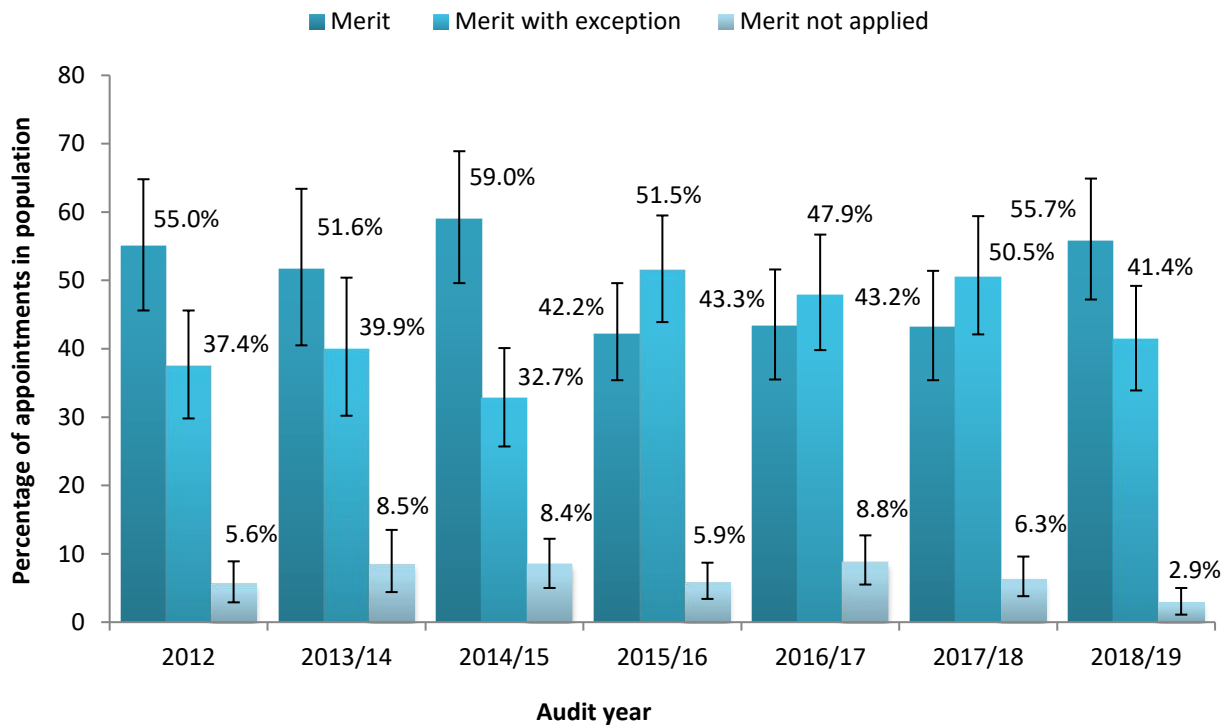
**Notes:**

- 1: Not all BC Public Service appointments are stored in the same database. Prior to 2015/16, samples were pulled from each separate database at a fixed sampling rate. From 2015/16 onwards, the appointments from separate databases were combined prior to sampling taking place.
- 2: Changes were made to the 2011 merit performance audit approach. See the Merit Commissioner's *2011/2012 Annual Report* for details.
- 3: First partial fiscal audit from September 1, 2013 to March 31, 2014. Organization database strata reduced from three to two; the Forensic Psychiatric & Riverview Hospitals no longer fall under the Merit Commissioner's oversight. Organization size strata reduced from four to two.
- 4: First complete fiscal audit.
- 5: Although two organization databases remain, population data is merged prior to drawing samples.
- 6: Changes were made to the 2016/17 Merit Performance Audit approach. Refer to *Merit Performance Audit 2016/17* report for more details on the modifications.
- 7: Refinements were made to the 2017/18 audit in error identification for inventories. Refer to Appendix B in *Merit Performance Audit 2017/18* report for more details.
- 8: An unanticipated error during the first interval of the 2018/19 audit resulted in the need for stratification in the third and fourth intervals. Those samples were further stratified by source list (Agency versus LDB) and employee status ("new" versus "existing").



Chart 1 illustrates the estimated year-over-year merit performance audit results for the population of public service appointments, with confidence intervals shown as error bars.

**Chart 1 – Population Estimates for the Recruitment and Selection Process Findings**



**Notes:**

- Error bars depict 95 per cent confidence intervals around each population estimate.
- Direct appointments were excluded from the population of appointments starting in 2015/16.
- The former “did not demonstrate” findings were consistently less than 2 per cent and are not represented in this chart. In 2016/17, this type of finding was redefined as “merit not applied”.
- Caution should be applied when comparing 2016/17 and 2017/18 audit results to prior year-to-year results, as well as each other, due to audit changes made in 2016/17 and 2017/18.

Considering the sample sizes used and the consistently-applied sampling methodology, the results from the 2018/19 Merit Performance Audit offer a reasonably good degree of comparability to 2017/18 Merit Performance Audit findings, as well as to previous year’s audit findings. Given the precision of the estimates, the samples and subsequent audit findings can be stated to be of reasonable statistical strength.