



Office of the
Merit Commissioner

2019/20

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

UPHOLDING FAIR HIRING IN THE
BC PUBLIC SERVICE

December 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 *2019/20 Merit Performance Audit Report*, which is provided to the Legislative Assembly and published on the website of the Office of the Merit Commissioner (the Office). The purpose of this report is to provide information on the population of appointments, sampling methodology, and method of extrapolation underpinning the 2019/20 Merit Performance Audit.

Appointment Population

The 2019/20 audit included appointments made from April 1, 2019, to March 31, 2020. 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, 2019;
- July 1 – September 30, 2019;
- October 1 – December 31, 2019; and
- January 1 – March 31, 2020.

Lists of appointments made for organizations identified in Appendix A of the *2019/20 Merit Performance Audit Report*, were obtained from the BC Public Service Agency (Agency) from the Corporate Human Resource Information and Payroll System, 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 7,751 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 monitor the application of the merit principle 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 appointments¹. For an overview of how the sample compares to the population of appointments, see the section titled “Distribution of Audits”. The final sample is representative of the population of appointments, and the final weighted estimates in Table 6 may be generalized to all permanent appointments and temporary appointments over seven months that came into effect between April 1, 2019, and March 31, 2020.

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 requirements. The degree of precision for the confidence level and margin of error for the confidence interval were set to a maximum of 95 percent and ± 6 percent, respectively, for the “merit not applied” finding. When this single proportion is estimated at the conservative value of 50 percent 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. Although the rate of out-of-scope appointments decreased from 6.2 to 2.5 percent in the 2018/19 audit, the Office elected to retain a total sample size of 280, with a sample of 70 selected at each sampling interval, to provide a buffer to a rate of out-of-scope appointments of up to 7.1 percent.

The Office drew simple random samples for each of the four intervals, using a random number generator to randomize the appointments for the selection of each sample. 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 1 summarizes the four independent samples drawn during the 2019/20 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, 2019	2,244	70	3.1%
Jul 1 – Sep 30, 2019	2,232	70	3.1%
Oct 1 – Dec 31, 2019	1,596	70	4.4%
Jan 1 – Mar 31, 2020	1,679	70	4.2%
Total	7,751	280	3.6%

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



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

Of the 280 randomly-sampled appointments, the Office identified 13 out-of-scope appointments (4.6 percent of the overall sample), primarily due to coding errors in the source data. This represents an increase in the rate of out-of-scope appointments. These 13 appointments were removed from the sample, leaving 267 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 7,413 is shown in Table 2 along with the in-scope populations, sample totals of appointments, and proportions of the population sampled, across audit years since 2014/15. The statistics presented in the last two sections of this report are based on the in-scope population.

Table 2: Year-Over-Year Comparison of In-Scope Population and Sample Size

Year	Number of appointments	Number of audits	Proportion of population sampled ¹
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%
Fiscal 2019/20	7,413	267	3.6%

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. From 2016/17 onwards, a fixed sample size approach was used to achieve a 95 percent confidence level and ± 6 percent margin of error for the “merit not applied” finding. The respective values for these years represent the proportion of the population that was audited.

Distribution of Audits

Tables 3, 4 and 5 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 (± 5 percent) between the sample and population percentages indicates that even though the sample itself was not stratified based on these variables, the 2019/20 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 3, 4, and 5 represent actual values found in the sample and population, without the 13 out-of-scope appointments, hence the totals sum to 7,738 and 267 appointments respectively for the total number of appointments and the number of audits.²

Table 3: Audits by Appointment Type

Appointment type	Total number of appointments	Percent of all appointments	Number of audits	Percent of all audits
Permanent	7,166	92.6%	253	94.8%
Temporary over 7 months	572	7.4%	14	5.2%

Table 4: Audits by Organization Size

Organization size	Total number of appointments	Percent of all appointments	Number of audits	Percent of all audits
Large (> 1,000 employees)	6,450	83.4%	225	84.3%
Small (\leq 1,000 employees)	1,288	16.6%	42	15.7%

Table 5: Audits by Job Classification Group

Job classification group	Total number of appointments	Percent of all appointments	Number of audits	Percent of all audits
Administrative support	1,530	19.8%	53	19.9%
Enforcement & corrections	484	6.2%	21	7.9%
Finance & economics	337	4.3%	11	4.1%
Health, education & social work	882	11.4%	24	9.0%
Information technology	371	4.8%	14	5.2%
Legal counsel	105	1.4%	3	1.1%
Management band & executive	1,354	17.5%	58	21.7%
Science & technical officers	850	11.0%	26	9.7%
Senior administration & research	1,649	21.3%	53	19.9%
Trades & operations	176	2.3%	4	1.5%

² 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 2019/20 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 merit performance audit, a rare event is 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 percent 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 6, 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
2019/20 Audit	Merit not applied	5.6%	5.7%	3.1%	8.8%
	Merit with exception	36.7%	37.2%	30.1%	44.7%
	Merit applied	57.7%	57.1%	48.2%	66.3%

In the 2019/20 audit, the extrapolated estimates suggest that appointments with a “merit not applied” finding make up 5.7 percent of all appointments; however, the true proportion of appointments with a “merit not applied” finding may lie as low as 3.1 percent and as high as 8.8 percent in the total population. The margin of error for this finding is smaller (i.e., more precise) than the set precision level of ± 6 percent, at approximately ± 3 percent. The true proportion of appointments with a “merit with exception” finding may lie as low as 30.1 percent and as high as 44.7 percent. The true proportion of appointments with a “merit” finding may lie as low as 48.2 percent and as high as 66.3 percent.

As in the two previous fiscal year audits, the weighted estimates for the audit findings in Table 6 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 percent) 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 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, 2019, and March 31, 2020. In terms of year-over-year comparisons, the number of audits conducted in the 2019/20 fiscal year (267) was similar to that in 2018/19 fiscal year (273) as well as the 2017/18 fiscal year (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 2017/18, 2018/19, and 2019/20 results to prior merit performance audits, 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 7 summarizes changes made since 2014/15 to the sampling and audit approach.

Table 7: Sampling and Audit Approach Changes									
Year	Appointment types audited			Strata					Audit finding changes
	Permanent	Temporary over 7 months	Direct	Organization database ¹	Sampling interval	Organization size	Appointment type	Employee status	
2014/15	✓	✓	✓	✓	✓	✓	✓		
2015/16 ²	✓	✓			✓		✓		
2016/17 ³	✓	✓			✓				✓
2017/18 ⁴	✓	✓			✓				✓
2018/19 ⁵	✓	✓		✓	✓			✓	
2019/20	✓	✓			✓				

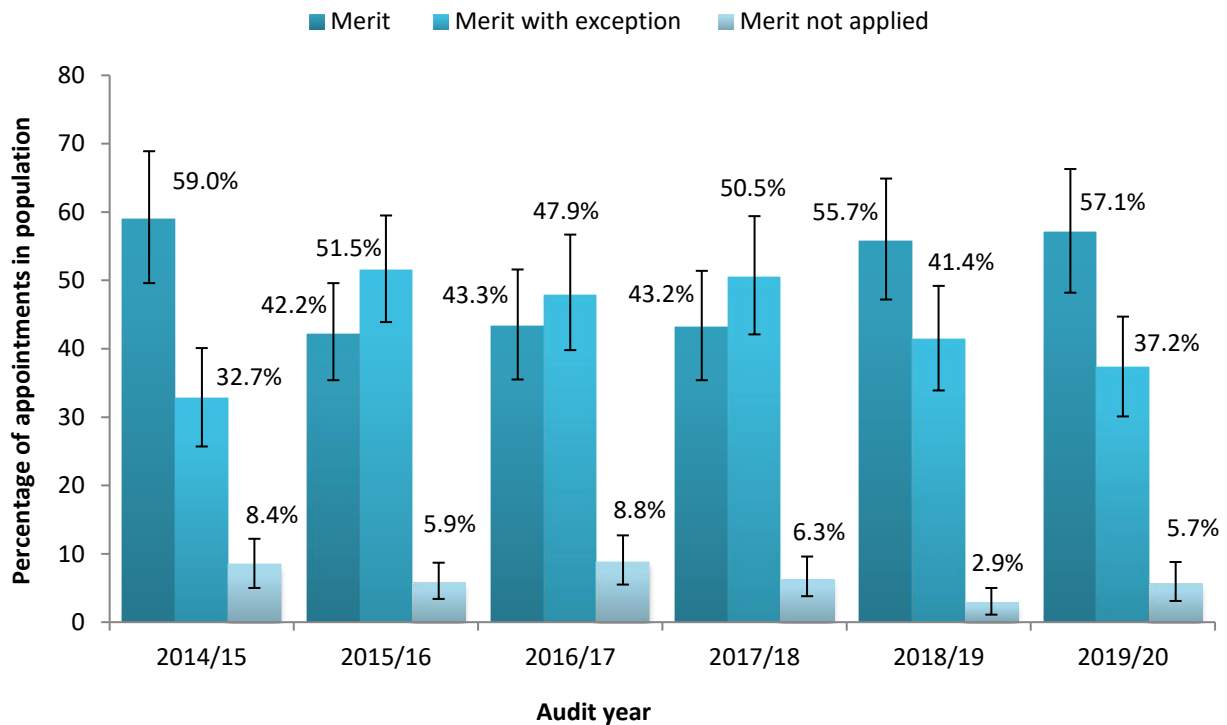
Notes:

- 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: Although two organization databases remain, population data is merged prior to drawing samples.
- 3: 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.
- 4: 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.
- 5: 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 percent 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 percent and are not represented in this chart. In 2016/17, this type of finding was included as part of the “merit not applied” finding.
- 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 2019/20 Merit Performance Audit offer a good degree of comparability to the 2018/19 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.