

2021/22

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

UPHOLDING FAIR HIRING IN THE
BC PUBLIC SERVICE

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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 Merit Commissioner determines whether recruitment and selection processes resulted in appointments based on merit, and whether individuals possessed the required qualifications for the position to which they were appointed. The Office of the Merit Commissioner reports the results of our audits to organization heads and the Deputy Minister of the BC Public Service Agency (Agency Head). We summarize the overall results and analysis of our findings in our annual Merit Performance Audit Report which we provide to the Legislative Assembly and publish on our website. The purpose of this report is to provide information on the population of appointments, sampling methodology, and method of extrapolation underpinning the 2021/22 Merit Performance Audit.

Appointment Population

The 2021/22 audit included appointments made from April 1, 2021, to March 31, 2022. 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 of the Merit Commissioner has divided the year into four intervals:

- April 1 – June 30, 2021;
- July 1 – September 30, 2021;
- October 1 – December 31, 2021; and,
- January 1 – March 31, 2022.

We obtained lists of appointments made for organizations identified in Appendix A of the *2021/22 Merit Performance Audit Report* from the BC Public Service Agency (Agency) and from the BC Liquor Distribution Branch (LDB), which retains appointment details independently. We requested the appointment population lists a few days after the end of each interval. This may have resulted in some appointments being missed due to the timing of when relevant information was added to the system. Every year we do an analysis of these missed appointments to ensure the sample reflects the majority of appointments made.

Prior to selecting each sample, we reviewed the interval appointment population lists to identify duplicate appointments. These entries were investigated to determine whether they represented unique and eligible appointments for the audit. Duplicate entries and any appointments deemed ineligible 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, the total population of appointments was 7,860.



Sample Selection

We selected a simple random sample of permanent appointments and long-term (over 7 months) temporary appointments. 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 sample we select each year is representative of the total population of appointments, which we can reasonably use to extrapolate the sample results to the total population of appointments. The weighted extrapolation of the population is shown in Table 6. As a result, the sample may be generalized to all permanent appointments and long-term temporary appointments that were made between April 1, 2021, and March 31, 2022.

Prior to 2016/17, we selected a percentage of the appointments from the population to audit. This meant that the number of appointments we audited each year fluctuated according to the size of the population. For operational reasons, we changed our practice in 2016/17 to select a fixed number of appointments from the population each year. We are confident that our set sample size of 280 appointments provides meaningful statistical information on the following basis:

- The degree of precision for the confidence level is set to a maximum of 95% with a margin of error for the confidence interval at $\pm 6\%$ for the “merit not applied” finding.
- For a population of 10,000 appointments or less, the largest sample size required is 260.

The 2021/22 appointment population was 7,860 and our initial sample was 280 appointments. Of these appointments, 11 were out-of-scope - a rate of 3.9%. Out of scope appointments can refer to short-term temporary appointments, or voluntary demotions. This out-of-scope rate is identical to that reported in the 2020/21 report and similar to previous years. We select a higher number of appointments than the required 260 in order to allow for appointments which are included in the appointment lists but are not considered in-scope to audit.

Our sample was stratified by four quarters over the 2021/22 fiscal year. We used a random number generator to randomize and select the appointments to audit for each of the three-month periods. This approach allowed us to collect and audit appointments close to the time that they occurred. It is our view that stratifying the sample by these time periods makes it easier for hiring managers to be available and recall the process. It also allows us to issue individual audit reports sooner, providing timely and constructive information to those who receive the report. 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 these four independent samples.

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



Table 1: 2021/22 Population, Sample Size, and Proportion Sampled

Sampling interval	Population	Sample size	Proportion sampled
Apr 1 – Jun 30, 2020	1,856	70	3.8%
Jul 1 – Sep 30, 2020	1,761	70	4.0%
Oct 1 – Dec 31, 2020	1,697	70	4.1%
Jan 1 – Mar 31, 2021	2,546	70	2.7%
Total	7,860	280	3.6%

To minimize any bias introduced by the varying proportions sampled in the final population estimates, a post-stratification weighting adjustment was applied, that is, four unique weights were created to adjust for bias in the overall sample.

We removed the 11 appointments identified as out-of-scope from the sample, leaving 269 in-scope appointments which were subsequently audited. The Office used this information to estimate back to the original population how many appointments would likely be in scope if the entire population of appointments was audited. The result was an adjusted in-scope population of 7,534. The statistics presented in the last two sections of this report are based on the in-scope population. Table 2 shows the adjusted populations with the proportions of the population sampled since 2016/17.

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 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%
Fiscal 2020/21	5,445	269	4.9%
Fiscal 2021/22	7,534	269	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

We reviewed our sample of 269 appointments to see if it was representative of the population of appointments from which it was drawn. This included comparing the distribution of the sample and the population appointments by three variables: appointment types, organization sizes, and job classification groups.

We found a small difference in values ($\pm 5\%$) between the sample and population percentages. This finding indicates that even though the sample was not stratified by these variables, the 2021/22 sample was proportionately representative of the total population of appointments for the same period. Tables 3, 4 and 5 show our findings by variable of comparison. For these comparisons, we used the 269 in-scope appointments from our sample and a population number of 7,849 which is all of the 7,860 appointments that occurred over the fiscal year minus the 11 appointments known to be out-of-scope. The extrapolated in-scope population was found to be 7,534 for this fiscal year.

This fiscal year, in Tables 3, 4, and 5 the differences between the sample size and the audited competitions all fell between $\pm 5\%$. In previous years, due to randomized sampling, some values are slightly over or underrepresented.

Table 3: Audits by Appointment Type

Appointment type	Total number of appointments	Percent of all appointments	Number of audits	Percent of all audits
Permanent	7000	89.2%	251	93.3%
Temporary over 7 months	849	10.8%	18	6.7%

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)	6450	82.2%	221	82.2%
Small (\leq 1,000 employees)	1399	17.8%	48	17.8%



Table 5: Audits by Job Type

Job classification group	Total number of appointments	Percent of all appointments	Number of audits	Percent of all audits
Admin Support	1567	20.1%	56	21.2%
Enforcement & Corrections	333	4.3%	7	2.7%
Executive	17	0.2%	0	0%
Finance & Economics	341	4.4%	9	3.4%
Health, Education & Social Work	816	10.5%	30	11.4%
Information Technology	468	6.0%	19	7.2%
Legal Counsel	124	1.6%	4	1.5%
Management Band	1430	18.3%	52	19.7%
Science & Technical Officers	801	10.3%	22	8.3%
Senior Admin & Research	1816	23.3%	64	24.2%
Trades & Operations	91	1.2%	1	0.4%

Note: Percentages may not add to 100% due to rounding

Estimates and Confidence Intervals

To determine the probability that our sample audit findings (i.e., “merit”, “merit with exception” and “merit not applied”) would be replicated in the population of appointments, the Office applied confidence intervals to the estimates for the 2021/22 audit. We used the Poisson distribution method which is appropriate for generating estimates of independent but rare events. For the purposes of our audit, a rare event is the “merit not applied” finding which occurs infrequently. We have used this method of estimation since the 2010 Merit Performance Audit.

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

A 95% confidence interval means that with repeated sampling, the true population value of that finding would lie 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 were within the lower and upper limits of the respective confidence intervals 95 times out of 100.



Table 6: Extrapolated Estimates – Audit Findings and Confidence Intervals

Audit	Audit finding	Sample appointments audited	Estimate (weighted)	95% Confidence interval	
				Lower	Upper
2021/22 Audit	Merit not applied	5.9%	5.7%	3.1%	8.7%
	Merit with exception	34.9%	34.9%	28.1%	42.1%
	Merit applied	59.1%	59.4%	50.4%	68.8%

Note: Percentages may not add to 100% due to rounding

In the 2021/22 audit, the appointments with a “merit not applied” finding made up 5.7% of all appointments. The margin of error for this finding was smaller (i.e., more precise) than the set precision level of ±6 percent, at approximately ±3 percent. According to our confidence intervals, the true proportion of appointments with a “merit not applied” finding may be as low as 3.1% and as high as 8.7% of the total population, with a “merit” finding may be as low as 50.4% and as high as 68.8%, and a “merit with exception” finding may be as low as 28.1% and as high as 42.1%.

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 variability (e.g., errors, irregularity) associated with sampling and with any resulting statistics. We account for this expected variation by using a confidence interval around statistics of interest. Our confidence interval provides a level of precision as a percentage range around (above and below) the estimated population value for each of our findings.

The appointments selected for audit are a random sample from a list of appointments occurring between April 1, 2021, and March 31, 2022. In terms of year-over-year comparisons, the number of audits conducted in the 2021/22 fiscal year (269) was the same as 2020/21 (269), and was similar to that in fiscal years 2019/20 (267), 2018/19 (273) and, 2017/18 (259) due to the fixed sample size approach now used. Because of year-over-year changes in sampling approach, caution should be used when comparing results to samples prior to 2017/18.

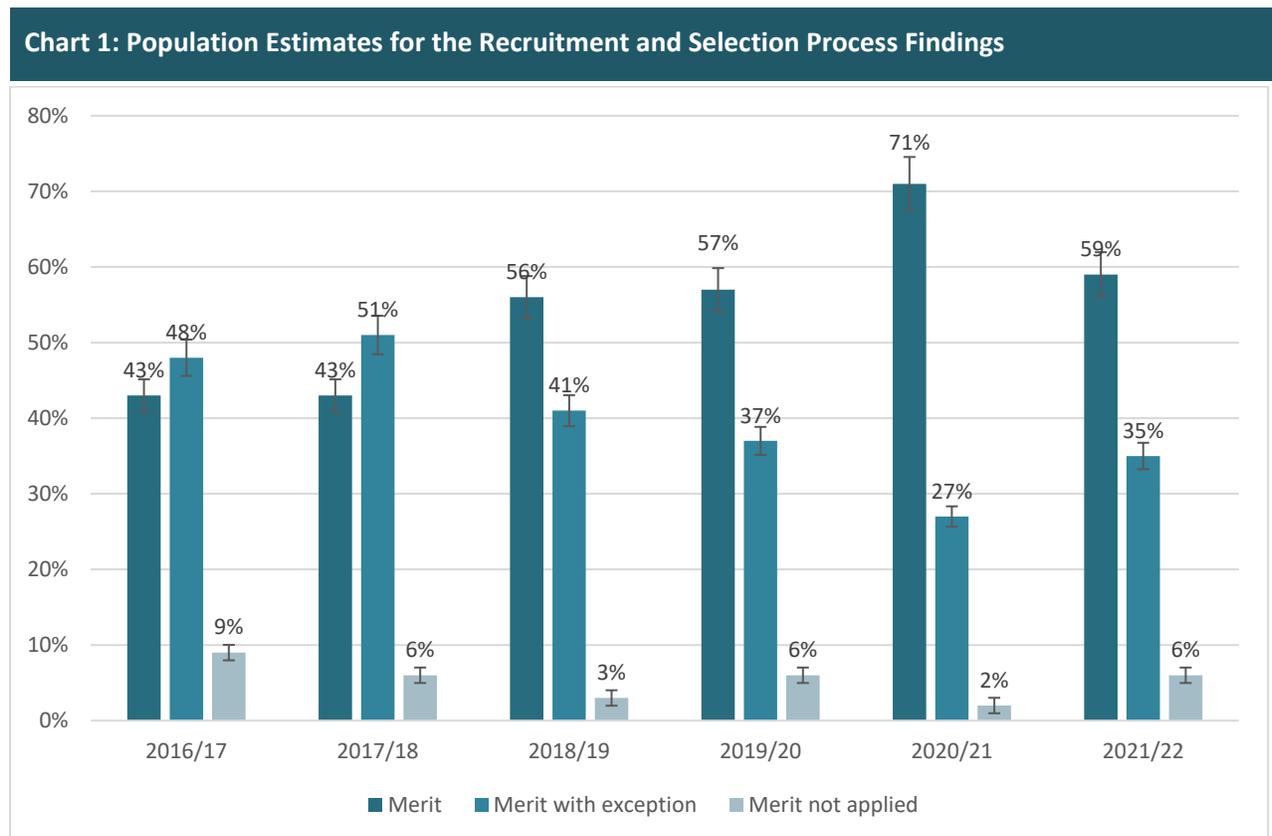
This year’s report did not include any significant changes in regards to sampling or approach changes. However, changes in approach to sampling and audit have been necessary to maintain data integrity and improve the quality of the audit. A brief summary of these changes is as follows:

- In 2016/17 a fixed sample size of 70 per quarter was established. To review this change in detail, review [Appendix B of the 2016/17 Audit report here](#).
- In 2017/18, the office changed [how we identified inventory errors](#).



- In 2018/19 there was a change in how errors were tallied. [This is detailed in Appendix B of the 2018/19 Audit Report.](#)
- 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 (core government versus Liquor Distribution Branch) and employee status (“new” versus “existing”). [This is outlined in appendix B of the 2018/19 Merit Performance Audit.](#)

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.



Notes:

- Error bars depict 95 % confidence intervals around each population estimate.
- Caution should be applied when comparing 2016/17 with other years due to a change in 2017/18 involving identifying errors in inventories

Considering the sample sizes used and the consistently-applied sampling methodology, the results from the 2021/22 Merit Performance Audit offered a good degree of comparability to previous years’ audit findings. Given the precision of the estimates, the samples and subsequent audit findings can be stated to be of reasonable statistical strength.