



Office of the
Merit Commissioner

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

2022/23

January 2024



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Background

The purpose of this report is to provide information on the population of appointments, sampling methodology, and method of extrapolation underpinning the 2022/23 merit performance audit.

Under section 8 of the *Public Service Act*, the Merit Commissioner is responsible for the application of the merit principle by performing random audits of BC Public Service appointments. The Merit Commissioner determines whether recruitment and selection processes resulted in appointments based on merit (as outlined in section 8 of the *Act*), and whether individuals appointed possessed the required qualifications for the position. The Office of the Merit Commissioner reports the audit results to organization heads and the deputy minister of the BC Public Service Agency and summarizes the overall results and analysis of our findings in our annual merit performance audit report. The report is provided to the Legislative Assembly and available on our website. All organizations identified in Appendix A of the *2022/23 Merit Performance Audit Report* are subject to random audit.

Appointment Population

The 2022/23 audit included appointments made from April 1, 2022, to March 31, 2023. Eligible appointments include permanent appointments and temporary appointments of more than seven months. To run an efficient audit and provide timely feedback, year is divided into four intervals:

- April 1 – June 30, 2022;
- July 1 – September 30, 2022;
- October 1 – December 31, 2022; and,
- January 1 – March 31, 2023.

Lists of appointments, for organizations subject to audit for the relevant time period, are obtained from the BC Public Service Agency (PSA) and from the BC Liquor Distribution Branch (LDB), which retains appointment details independently. We request the appointment population shortly after the end of each interval. Depending on when appointment information is added to the system, this can result in some appointments not being captured in the appropriate interval. Each year we do an analysis of these “missed” appointments to ensure the sample reflects the majority of appointments made. This year, to verify if the “missed” appointments remain within an acceptable margin, the office will complete an analysis of samples 1 and 2 in winter 2024. The intention of this analysis will be to determine if changing the data collection period to later after the end of the interval, fewer appointments might be missed.

Prior to selecting the sample for each interval sample, we review the interval appointment population lists to identify duplicate appointments. These entries are investigated to determine whether they represent unique and eligible appointments for the audit. Duplicate entries and any appointments deemed ineligible are removed from the population list. For each sampling interval, the lists from the PSA and the LDB are combined to form a single



appointment population list from which the sample can be drawn. As of March 31, 2023, the end of the fiscal year, the total population of appointments was 10,970.

Sample Selection

We select 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, 2022, and March 31, 2023.

Prior to 2016/17, we selected a percentage of the appointments from the population to audit. This meant that the number of appointments audited each year fluctuated according to the size of the population. In 2016/17, for operational reasons, the practice changed 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 as:

- 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 12,000 appointments or less, the sample size required is 261.

The 2022/23 appointment population was 10,970 and our initial sample was 280 appointments. Of these appointments, 12 were out of scope - a rate of 4%. Out-of-scope appointments can refer to short-term temporary appointments, or voluntary demotions. This out-of-scope rate is similar to that reported in the 2021/22 report and previous years. We select a higher number of appointments than required, given the population size in order to allow for out-of-scope appointments which are included in the initial appointment lists. Our office is mindful that the increased number of appointments will require an increased sample size to maintain the statistical confidence level. In the 2023/24 fiscal year, we have begun to select a larger sample.

Our sample was stratified by four quarters over the 2022/23 fiscal year. We used a random number generator to randomize and select the appointments to audit for each of the three-month intervals noted above. This approach allows 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 reports. Since each interval includes a different number of appointments, this results in

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



a different proportion of each interval being represented in the overall sample. Table 1 summarizes these four independent samples.

Sampling interval	Population	Sample size	Proportion sampled
Apr 1 – Jun 30, 2022	2,521	70	2.8%
Jul 1 – Sep 30, 2022	2,804	70	2.5%
Oct 1 – Dec 31, 2022	2,490	70	2.8%
Jan 1 – Mar 31, 2023	3,155	70	2.2%
Total	10,970	280	2.6%

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.

Twelve appointments identified as out of scope from the sample and removed, leaving 268 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 were audited. The result was an adjusted in-scope population of 10,525. 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.

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%
Fiscal 2022/23	10,525	268	2.5%

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

The sample of 268 appointments was reviewed to confirm 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 ($\pm 6\%$) between the sample and population percentages. This finding indicates that even though the sample was not stratified by these variables, the 2022/23 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 268 in-scope appointments from our sample and a population number of 10,958 which is all of the 10,970 appointments that occurred over the fiscal year minus the 12 appointments known to be out of scope. The extrapolated in-scope population was found to be 10,525 for this fiscal year.

This fiscal year, in tables three, four, and five, the differences between the sample size and the audited appointments 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	9919	90.5%	236	88.1%
Temporary over 7 months	1039	9.5%	32	11.9%

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)	8768	80.0%	213	79.5%
Small (\leq 1,000 employees)	2190	20.0%	55	20.5%



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	4227	38.5%	109	39.1%
Enforcement & Corrections	296	2.7%	8	2.9%
Executive	10	0.09%	0	0.0%
Finance & Economics	487	4.4%	9	3.2%
Health, Education & Social Work	1283	11.7%	49	17.6%
Information Technology	53	0.5%	2	0.7%
Legal Counsel	132	1.2%	3	1.1%
Management Band	1839	16.8%	41	14.7%
Science & Technical Officers	1865	17.0%	41	14.7%
Senior Admin & Research	184	1.7%	6	2.2%
Trades & Operations	592	5.4%	11	3.9%

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 2022/23 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 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
2022/23 Audit	Merit not applied	16	5.9%	3.3%	9.0%
	Merit with exception	79	29.7%	23.5%	36.5%
	Merit applied	173	64.4%	55.1%	74.3%

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 5.9% 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 3.3% and as high as 9.0% of the total population, with a “merit” finding may be as low as 55.1% and as high as 74.3%, and a “merit with exception” finding may be as low as 23.5% and as high as 36.5%.

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, 2022, and March 31, 2023.

In terms of year-over-year comparisons, the number of audits conducted in the 2022/23 fiscal year was very close to the rate that was seen in the 2021/22 fiscal year (269), 2020/21 (269), 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 2016/17.

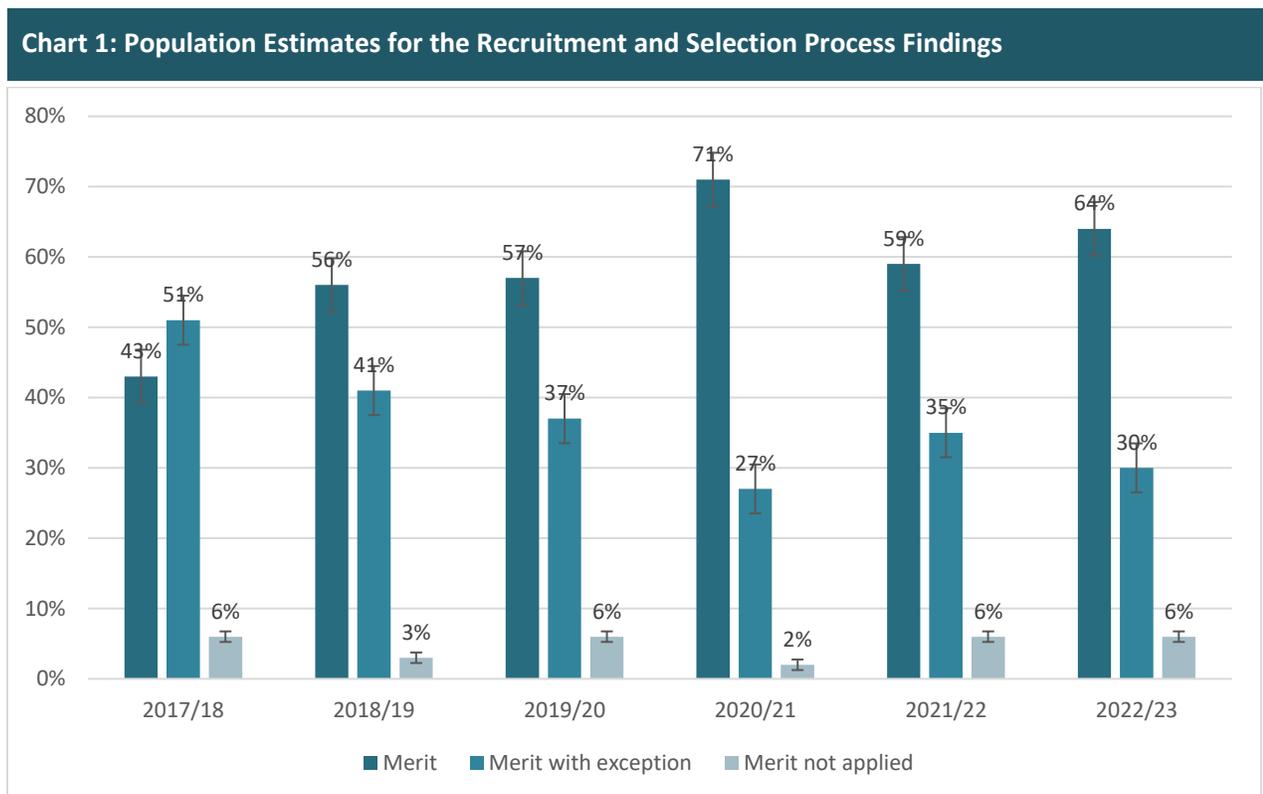
This year did not include any significant changes in regards to sampling or approach. However, changes in approach to sampling and audit have been necessary to maintain data integrity and improve the quality of the audit. A brief summary of these changes is as follows:

- 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.

Considering the sample sizes used and the consistently-applied sampling methodology, the results from the 2022/23 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.