Random Selection for the Merit Performance Audit

2016/17

UPHOLDING FAIR HIRING IN THE
BC PUBLIC SERVICE

Prepared by the Office of the Merit Commissioner

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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. The overall results and analysis of findings are summarized in a report titled *Merit Performance Audit 2016/17*, which is published on the Merit Commissioner's website and provided to the Legislative Assembly.

In previous years, BC Stats conducted the random sampling of appointments and resulting statistical analysis, as well as the preparation of this report. In 2015/16, a transition was made where BC Stats drew the first three samples, and provided direction and support to the Office for drawing the fourth sample, conducting the statistical analysis, and preparing this report. This year marks the first year where the Office has conducted this work independently.

The purpose of this report is to elaborate on the population of appointments, sampling methodology, and method of extrapolation underpinning the *Merit Performance Audit 2016/17*, which is published separately on our website.

Appointment Population

The 2016/17 audit timeframe was April 1, 2016 to March 31, 2017. The types of appointments audited included permanent appointments and temporary appointments of more than seven months. Unlike previous years, direct appointments under section 10(b) of the *Act* were not included in either the 2015/16 or 2016/17 audit. Based on these parameters, a total population of 5,934 appointments was identified.

Sample Selection

Objectives

The objective of the merit performance audit is to randomly sample permanent appointments and temporary appointments greater than seven months in order to obtain an unbiased picture of the application of the merit principle under the *Act*. A simple random sample is considered a statistically representative sample of the population of appointments, from which results can be generalized to the total population of appointments[1].

Stratifying the population prior to sampling to achieve a proportionally representative sample for specific groups has been conducted in the past, but has resulted in complex sampling schemes. In an effort to manage these concerns, the degree of stratification has been reduced over the last several audits. For the 2015/16 audit, organization size (over 1,000 employees and under 1,000 employees) was eliminated as a strata because there has been insufficient evidence of hiring practices varying by organization size. In 2016/17, appointment type (permanent and temporary over 7 months) was eliminated as a strata for the same reason, resulting in no additional strata beyond sampling interval, a necessary practicality as described in the section titled "Random Selection of Cases". With these changes, the 2016/17 sample still retains the same degree of statistical representativeness of the population of appointments.

Random Selection of Cases

Eligible BC Public Service appointments took place across the entire fiscal year. In order to run an efficient audit and provide timely feedback, the Office divided the year into four sampling intervals. An appointment population list of eligible appointments was obtained from the BC Public Service Agency and the BC Liquor Distribution Branch (which stores appointment details independently) for each of the following sampling intervals:

- ➢ April 1 – June 30, 2016;
- ➢ July 1 – September 30, 2016;
- ➢ October 1 – December 31, 2016; and
- ➢ January 1 – March 31, 2017.

Prior to selecting the sample, the Office reviewed each appointment population list to identify employees appearing more than once in the list. 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

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

interval, the lists from the BC Public Service Agency and the Liquor Distribution Branch were combined to form a single appointment population list from which the sample could be drawn.

After extensive consultation with Statistics Canada, the sampling approach for the 2016/17 audit was changed to a fixed sample size to better meet operational demands, and more importantly, to ensure the desired precision would be met for the projected estimated findings, regardless of the size of the population of appointments. The degree of precision for the confidence level and margin of error for the confidence interval, were set to a maximum of 95% and ±6%, respectively, for the "merit not applied" finding.

When the desired confidence level is set at 95%, the margin of error is set at 6%, a single proportion is estimated at the conservative value of 50%, and the maximum population of appointments is not expected to exceed 10,000, it can be determined that the largest sample size the Office would require to meet these criteria is 260. Given a maximum anticipated rate of 3% out-of-scope appointments, a total sample size of 268 was selected, with a sample of 67 selected at each sampling interval.

The Office drew all four samples using the approved methodology provided by BC Stats. For each interval the Office used a random number generator to randomize the appointments for selection of the sample. Since each sampling interval included a different number of appointments, this resulted in a different proportion of each interval being represented in the population (see Table 1). A post-stratification weighting adjustment ensured that any bias introduced by this variation was minimized in the final population estimates. In total, a set of four unique weights were created to adjust for bias in the overall sample.

Table 1 summarizes the four independent samples drawn during the 2016/17 fiscal year period for auditing, as well as the proportion sampled in each interval.

Table 1: 2016/17 Population, Sample Counts, and Proportion Sampled			
Sampling Interval	**Population**	**Sample Size**	**Proportion Sampled**
Apr 1 – Jun 30, 2016	1,527	67	4.4%
Jul 1 – Sep 30, 2016	1,628	67	4.1%
Oct 1 – Dec 31, 2016	1,298	67	5.2%
Jan 1 – Mar 31, 2017	1,481	67	4.5%
Total	5,934	268	4.5%

Of the 268 randomly-sampled appointments, the Office identified 11 cases (4.1% of the overall sample) as being out-of-scope, primarily due to coding errors in the source data. These 11 cases were removed from the sample, leaving 257 in-scope appointments, which were all subsequently audited. The Office

used the strata information to estimate back into the original population how many cases would likely be deemed out-of-scope if the entire population of cases had been audited. The statistics presented in the next section of the report are based on this reduced population—257 in-scope appointments out of an adjusted in-scope population of 5,685.

Table 2 summarizes the in-scope population and sample totals of appointments across audit years since 2011.

Table 2: Year-Over-Year Comparison of In-Scope Population and Sample Counts			
Year	Number of Appointments	Number of Audits	Sampling Rate
2011	3,942	222	5.6%
2012	3,928	256	5.8%
Fiscal 2013/14[1]	2,010	150	7.5%
Fiscal 2014/15	3,915	243	6.2%
Fiscal 2015/16	5,343	321	6.0%
Fiscal 2016/17[2]	5,685	257	4.5%

Notes:
1: The 2013/14 audit was the first fiscal year audit, which covered seven months of appointments from September 1, 2013 to March 31, 2014.
2: The sampling rate for the 2016/17 audit represents the proportion of the population that was audited, rather than a rate that was applied to the population to obtain a sample.

Estimates and Confidence Intervals

In order to apply confidence intervals to the estimates for the 2016/17 audit, the Office employed a methodology that was similar to what was used in audits from 2010 to 2015/16. As with those previous audits, the confidence intervals in 2015/16 were based on a Poisson distribution, whereas the confidence intervals from years prior to 2010 employed an F-distribution. While both methods provided accurate estimates, the Poisson is more appropriate for generating estimates for rare events. For the purposes of the merit findings and the performance audit report, a rare event would include findings that do not occur frequently, such as the "merit not applied" finding and the previously used finding "did not demonstrate".

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

The 95% confidence interval can be interpreted as: the true statistic would be found within the upper and lower bounds for that interval 95 times out of 100 with repeated sampling. In Table 3, the true population estimate for the "merit not applied", "merit with exception", and "merit" findings will lie

within the lower and upper bounds of the respective confidence intervals 19 times out of 20. Given that the "did not demonstrate" finding is no longer used in the merit performance audit, no confidence interval is presented for this finding.

Table 3: Estimated Audit Findings and Confidence Intervals				
Audit	Audit Finding	Estimate (weighted)	95% Confidence Interval	
			Lower	Upper
Fiscal 2016/17 Audit	Merit Not Applied	8.81%	5.52%	12.73%
	Merit With Exception	47.93%	39.78%	56.68%
	Merit Applied	43.25%	35.53%	51.59%

In the 2016/17 audit, it is estimated that appointments with a "merit not applied" finding make up an estimated 8.81% of all appointments. The true proportion of appointments with a "merit not applied" finding may lie as low as 5.52% and as high as 12.73% in the total population. Despite the higher proportion of out-of-scope appointments, the margin of error is smaller (i.e., more precise) than the set precision level of 6% for this finding. The true proportion of appointments with a "merit with exception" finding may lie as low as 39.78% and as high as 56.68%. The true proportion of appointments with a "merit" finding may lie as low as 35.53% and as high as 51.59%.

Uses and Limitations of Audit Results

As was true in the past and continues to be true in the present, a certain degree of error and uncertainty is normally expected in sampling, as well as in the statistics of interest and the ranges of their probabilities. This expectation of error is captured through the application of the confidence interval. The confidence interval level (here 95%) describes the level of precision associated with a sampling method given a range of possibilities both above and below the found statistic (± a percentage range).

As sample size increases, the likelihood of variance (or difference within the samples when compared to one another) decreases, and so does the error associated with the sampling. However, it is the sample size in relation to the population size that is of importance. Samples should always strive 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 of all appointments, representative of the strata used in the sampling process occurring between April 1, 2016 and March 31, 2017. In terms of year-over-year comparisons, the number of audits conducted in fiscal 2016/17 (257) was less than in

2015/16 (321), even though the 2016/17 sample was drawn from a larger population of appointments. Due to year-over-year changes in sampling approach, caution should be used when comparing results to previous years. This applies in particular to comparing the 2016/17 results to prior merit performance audits due to the modifications that were introduced for the 2016/17 audit (please refer to the report *Merit Performance Audit 2016/17* for more details on the modifications). Table 3 summarizes changes made since 2011 to the sampling and audit approach.

| Table 4: Estimated Audit Findings and Confidence Intervals										
Year	**Appointment Types Audited**			**Strata**						**Audit Finding Changes**
	Permanent	Temporary over 7 months	Direct	Organization database[1]	Sampling interval	Administrative status	Organization size	Appointment Type	Bargaining Unit Status	
2011[2]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2012	✓	✓	✓	✓	✓	✓	✓	✓	✓	
2013/14[3]	✓	✓	✓	✓	✓		✓	✓		
2014/15[4]	✓	✓	✓	✓	✓		✓	✓		
2015/16[5]	✓	✓			✓			✓		
2016/17[6]	✓	✓			✓					✓

Notes:

1: Not all BC Public Service appointments are stored in the same database. Historically, samples were drawn from each separate database.

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* for more details on the modifications.

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

Chart 1 - Population Estimates for the Recruitment and Selection Process Findings
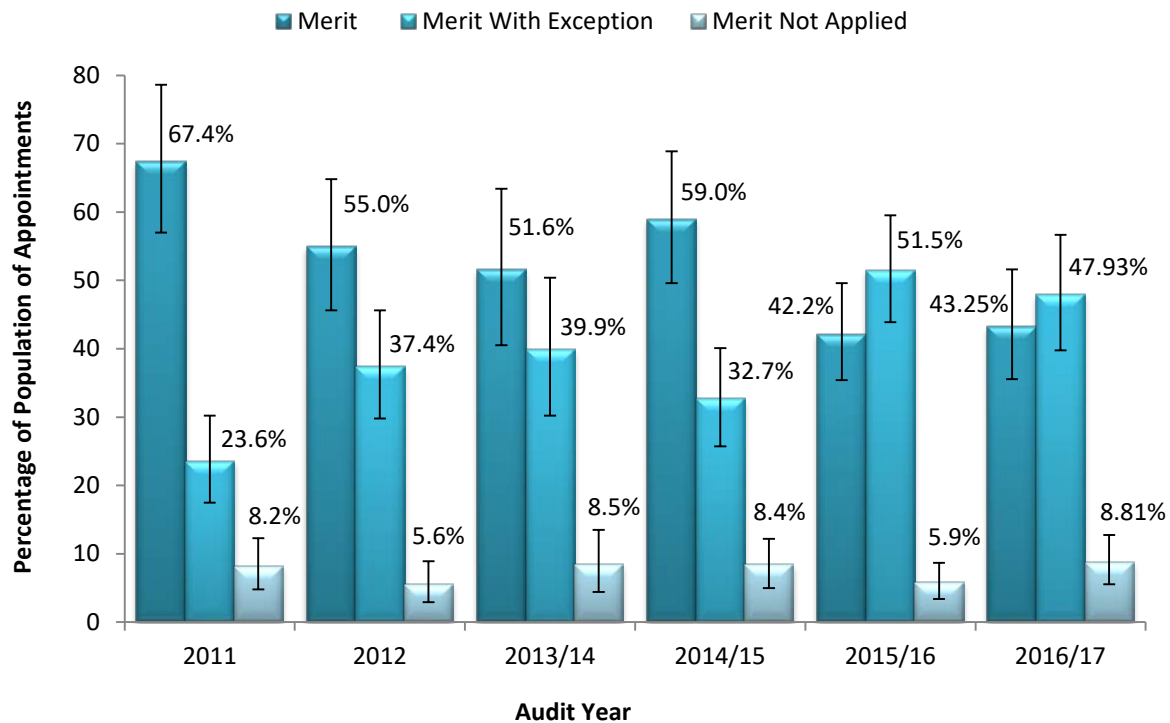
Notes:
- Error bars depict 95% confidence intervals around each population estimate.
- Direct appointments were excluded from the population of appointments for 2015/16 and 2016/17.
- The former "did not demonstrate" findings were consistently less than 2 per cent and are not represented in this chart. In 2016/17, this type of finding was redefined as "merit not applied".
- The 2016/17 merit performance audit approach removed documentation errors, resulting in fewer "merit with exception" findings and more "merit applied" findings than if the 2015/16 merit performance audit approach had been applied. Caution should be applied when comparing 2016/17 results to prior year-to-year results due to these changes.

Considering the changes made in the approach to the 2016/17 merit performance audit, the projected estimates and margins of error are not directly comparable to those of prior years[2] and must therefore be made with caution, and as with other comparisons, with consideration of the confidence intervals. Given the modifications to the sampling approach, the sample size used, the sampling methodology applied, and the precision of the estimates, the results from the 2016/17 merit performance audit can be stated to be of reasonable statistical strength, and will form a strong baseline as the Office moves forward with its modified audit approach.

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[2] Although the degree of change to the estimates and confidence intervals is unknown, it is surmised to be small.