Maclean's Ranking of Canadian Universities

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1 Introduction

Since 1991, Maclean's Magazine has published an annual article ranking all Canadian universities. Given the large and diverse audience reached by Maclean's Magazine, the potential, if not actual, influence of these articles on people's perceptions and actions is far-reaching. The high-school student may consider the rankings when selecting a university. The high-school counsellor may use the rankings as a basis for making recommendations. The employer may use the rankings to evaluate a job applicant based on which university s/he attended. Thus the ranking procedure should not be accepted uncritically but must be assessed as to whether it produces accurate and reliable results. Futhermore, the results must be interpreted correctly. This report seeks to address these issues.

Maclean's ranking procedure can be summarized as follows. Each university is placed in one of three categories (page 38 of the Maclean's article): Medical/Doctoral which offer a "broad range of PhD programs and research, as well as a medical school", Comprehensive which have "a significant amount of research activity and a wide range of programs", or Primarily Undergraduate with "relatively few graduate programs". Schools within each category are ranked against each other on 22 (21 for Comprehensive, 20 for Primarily Undergraduate) quality indicators (see Table A.3) and on a combined overall score. (All citations

from Maclean's articles refer to the 1998 edition unless noted otherwise.) The ranking for each indicator except for 'Reputational Survey' is derived from an underlying raw (quantitative) scale. For many indicators, these raw scores are presented in the article.

The Maclean's article does not give an exact formula for calculating the overall ranking. However, the article clearly identifies the weights that are assigned to each indicator for computing an overall score. We found that we could reproduce the article's overall ranking by combining the "standardized" raw scores for each indicator according to the given weights. The standardized raw scores for an indicator are obtained by first subtracting the mean and then dividing by the standard deviation of the score for the indicator. We have not verified with Maclean's that this is the actual algorithm. But this approach is both natural and reasonable and reproduces the published rankings. Therefore we expect that this algorithm is correct.

We restricted our analysis throughout to the Doctoral/Medical category of schools, but excluding Sherbrooke for which we have no data. All of the issues raised in this report apply equally well to analyses of the other categories of schools.

The "believability" of the rankings published by Maclean's rests on our confidence that (i) the 22 quality indicators in fact measure quality, (ii) the raw scores for the indicators are accurate, (iii) in computing the overall score, the weights reflect the perception in the population of the importance of each indicator, and (iv) differences in ranks represent meaningful differences in quality. Our aims are to illustrate the hazards of accepting criterion (iv) uncritically, and to address the impact of violations in various degrees of the first 3 criteria on the stability of the rankings.

The suitability of some of the indicators as measures of quality is discussed in Section 2. We focus on highlighting the difficulties of defining meaningful indices of quality. We do not present detailed alternative measures since in general, we can not calculate these with the given information.

In Section 3, we discuss displays of the standardized scores, of the ranks, and of the relationship between scores and ranks. These displays help us to properly interpret the rankings and to identify the characteristics of the data that may heavily influence the overall ranking. In particular, the pitfalls of using ranks as summaries are illustrated.

We investigate the sensitivity of the overall ranking to changes in the weights or the raw scores in Section 4. The weights are varied either systematically (to investigate the impact of specific weights of interest) or randomly through simulation (to assess rankings under a wide range of weight selections). To assess the impact of changes in the raw scores, we perturb these scores by a random "measurement error" that is intended to reflect uncertainty in the underlying data values.

We summarize our findings in Section 5 and discuss ways of improving the ranking procedure and the reporting of results.

2 What is Quality?

Deciding how to assess the quality of a university is not an easy task. Maclean's bases its assessments on six broad areas: the student body, classes, faculty, finances, library, and reputation. Within each area, quality is measured in terms of certain indicators. The broad areas that have been chosen are certainly subject to debate. And even if agreement on the choice of broad areas is reached, the choice of indicators to be used within each area is not always clear.

Do the Maclean's indicators measure quality? For instance, is a high per cent of students graduating indicative of a quality university? Presumably a quality education depends on accessibility of instructors; class size, one of the indicators used by Maclean's, gives some assessment of accessibility. But accessibility depends on more than class size. One must also consider access to instruction through problem sessions, tutorials and office hours. Maclean's does not account for these variables. Even if one feels that class size alone is an adequate measure of accessibility, one must still choose how class size is measured. Would the average class size be appropriate? The median class size? See Table A.3 for the calculation of Maclean's class size measure.

Some indicators may not be comparable across provinces, so their inclusion would bias the rankings. For instance, are differences in average entering grade among universities due to differences in high school grades in the provinces?

The data collected for the reputational survey raise the most concern. The survey attempts to measure *perceived* quality, which can be quite different from *actual* quality. Although, as Maclean's states on page 60 in the 1997 edition, "a solid reputation attracts the best students and professors", actual quality is probably the real draw. Even if measurement of perceived quality is the goal, who should assess this? To measure perceived quality "Maclean's sent surveys to 4,697 chief executive officers of cororations in every region, a broad range of university administrators, and high-school counsellors across Canada" (page 38). Are these the appropriate people to ask? Are they representative of some larger group whose opinion is relevant?

The biggest problem with the reputational survey is the low response rate. In 1998, only 12.4% of the 4,697 individuals surveyed provided their opinions (page 38). Are the opinions of the people who responded to the survey representative of all people who were mailed surveys? For instance, are graduates from particular universities more likely to respond? Would these universities then receive a higher rating? Without further data, there is no way of knowing the answers to these questions. Therefore the low response rate invalidates any conclusions that might be made from the survey data.

Since the role of the reputational survey information in assessing quality (actual or perceived) is suspect, we recalculated the rankings based on Maclean's calculations, but with the reputational ranking indicator removed. The results are described in Section 4, and are shown in Figure 6.

3 A Closer Look at the Data

Ranks alone do not provide an adequate summary for comparing quality across schools. In the absence of additional information one might assume that, for instance, the differences between the top-ranked school and the second-ranked school is the same as the difference between the second-ranked and third-ranked. However, one could more accurately assess these quality differences by studying any underlying quantitative scores that generated the rankings.

The extent of this problem is made clear by plotting, for each indicator, the raw score obtained by each school (Figures 1a-v). All of the scales are defined such that a larger score indicates higher quality. The plot for the indicator 'Class Sizes: 1st & 2nd Year' (Figure 1g) provides a striking example. In terms of ranks, the difference between McGill and UBC is large (second ranked versus sixth ranked), but the difference in the two raw scores is small. In comparison, the difference in raw scores between second-ranked McGill and first-ranked Western is large. The gap between second-to-last ranked Calgary and last ranked McMaster is even more dramatic, being almost as large as all of the other gaps combined.

The same phenomenom occurs in the overall rankings. The plot of the overall raw scores (Figure 2) indicates clearly that the spacings vary widely. The gap between the top-ranked school (Toronto) and the second-ranked school (Queen's) is relatively large. However, the gaps between some schools are small, so small that one might consider these schools as being tied. Furthermore, the rankings of these "almost tied" schools could be easily reversed by making small changes to either the weights assigned to the indicators or to the raw scores. The sensitivity of the overall ranking to such perturbations is discussed in detail in Section 4.

Figures 3 and 4 display the standardized scores of the individual indicators. The variables Q1-Q22 are defined in Table A.3. Figure 3 shows the scores for each indicator and Figure 4 shows them for each university. From Figure 3 we see that there are a few outlying scores. For instance, some university has an unusually negative score for 'Class Size: 1st & 2nd Year' (Q7). There is also an unusually negative score for 'Proportion who Graduate'. Figure 4 shows that McMaster and Calgary have a few unusually low scores. Direct inspection of the data set shows that McMaster fares very poorly in 'Class Size: 1st & 2nd Year' and Calgary fares very poorly on the indicator 'Proportion Who Graduate'. Thus we see that giving a large weight to the indicator 'Class Size: 1st & 2nd Year' would tend to lower McMaster's overall rank. In fact, the weight given to this indicator was moderately large (7%) suggesting that McMaster's rank might have been "dragged down" by this indicator. Similarly, Calgary's rank might be dragged down by its low score on the indicator 'Proportion Who Graduate'. However, this indicator was assigned a weight of only 2%, so probably Calgary's overall rank was not influenced much by this low score.

Schools with large positive standardized scores were Toronto (on the indicator 'Total Library Holdings') and Dalhousie ('Library Expenses'). If these indicators had been given

very large weights then Toronto's and Dalhousie's over-all scores would increase. But the relatively low weights (1% and 4%, respectively) on these indicators suggest that the overall ranks were not greatly influenced by these scores.

4 Sensitivity of the Overall Ranking

Clearly, the overall ranking can change if the weights assigned to the indicators are varied. In particular, if a school ranks first in one of the indicators, we can make it top-ranked overall simply by assigning 100% of the weight to that indicator. Since the majority of the schools rank first on at least one indicator we can in principle make almost any school rank first overall by changing the weights sufficiently. Similarly we can make almost any school rank last. However, we should work with weights that "reasonably" describe people's beliefs about the worth of each indicator. Unfortunately, we have no basis for deciding what are reasonable weights. Hence we proceed by assessing the sensitivity of the overall ranking to perturbations in the weights from the original weights used by Maclean's.

As one illustration of how ranks can change, consider Figure 5 in which a weight of 10% has been transferred from the variable 'Average Entering Grade' to 'Classes Taught By Tenured Faculty'. Here, the ranks of 7 of the 14 schools have changed with the largest change being Western's move from 5th to 2nd. As another example, we had indicated in Section 2 that the indicator 'Reputational Ranking' is perhaps unreliable and so it is of interest to see how the ranking changes if this indicator is excluded. Figure 6 shows that this exclusion results in a change in rank for 8 schools with the largest change being McMaster's drop from 6th to 9th place. In general, we have found that a school will seldom change by more than 2 ranks if the weights on only a few indicators are altered.

Note that a change in weights will often yield a change in ranks, but may yield only a small change in the raw scores. This is easily seen in Figures 5 and 6. Although some schools switched ranks, the change in their raw over-all scores is negligible. Once again, this phenomenom suggests that reporting only ranks may not adequately summarize the data.

We carried out computer simulation studies to obtain a more general assessment of the sensitivity of the overall ranking to the values of the weights. Specifically we generated a "population" of two thousand people, each person having a set of 22 weights. These two thousand sets of weights were generated from a Dirichlet distribution in such as way as to be perturbations of the Maclean's weights. We then used each "person's" weights to calculate that person's rankings. We carried this out twice, first with a low level of perturbation and then with a moderate level. To illustrate the values of weights chosen, Figure 7 shows the histograms of the random weights obtained for the first two indicators (i.e., 'Average Entering Grade' and 'Proportion with 75% or Higher') under each level of perturbation. Maclean's used weights 12% and 3% respectively. Under low perturbation, nearly all of the simulated weights lie in the ranges 8% to 16% for the first indicator and 1% to 5% for the second indicator. Under moderate perturbation, nearly all of the simulated weights lie in

the ranges 2% to 24% for the first indicator and 0% to 10% for the second indicator.

Figures 8 and 9 display the histograms of the resulting overall ranks. Under low perturbation (Figure 8) the rank for each school appears to be quite stable, nearly always staying at the original rank or going up or down by at most one rank. Under moderate perturbation (Figure 9) the spread in the ranks is much more noticeable. In fact, a substantial fraction of the ranks differ from the original ranking by as much as 2. And occasionally we see a difference as large as 3. There are several specific noteworthy features. The first is the consistency of Toronto in finishing first. It appears that one would need to dramatically alter the weights before Toronto would lose its #1 ranking. Another feature to note is the similarity of the histograms for McMaster and Alberta. This suggests that these two schools ought to be regarded as essentially equal in quality. Lastly, there appears to be a clear separation between those schools ranking 10th or lower and those ranking higher.

The overall ranking is not only affected by the choice of weights but it is also affected by the raw scores. The accuracy of these scores is uncertain since schools surely have varying accounting practices, record-keeping systems, definitions of parameters used in calculating the scores (e.g., student status), etc. To assess the impact of this uncertainty, we re-ranked the schools using the original set of weights but with values for each indicator that were randomly perturbed by 5% of the standard deviation of the scores on the given indicator. Figure 10 shows that the ranks of the schools are not affected much with this level of noise. We recognize that this crude choice for the noise level surely does not reflect the true measurement error and that we have neither the data nor the expertise to ascertain what would be an appropriate range. The main point here is that this source of uncertainty must be considered in order to assess properly the stability of the results generated by the Maclean's ranking procedure.

5 Conclusions And Recommendations

In our view, the general procedure used by Maclean's is sound. However, we feel that the implementation and the reporting of results can be improved in several ways.

We are concerned that some of the indicators may not reflect actual quality adequately either because there are flaws in the collection or processing of the data or the variable is not an intrinsic measure of actual quality. The indicator 'Reputational Survey' manifests both of these problems. The survey responses are most likely not representative of the population of interest. Moreover, this indicator measures perceived quality whereas the goal of Maclean's rankings seems to be assessment of actual quality. It would be more appropriate to create rankings based on the objective data only. One could then compare these rankings with subjective rankings generated through the reputational survey.

The emphasis on rankings in the article obscures the degree by which schools are better or worse. We feel that this information should be reported more clearly using plots such as

Figures 1 and 2 or other similar devices.

By manipulating the weights, an arbitrary rank can be obtained for nearly any school. Perturbing the weights just slightly from Maclean's weights might result in a change of a school's ranking of one place. With moderate perturbations schools often change by one or two ranks but almost never more than two ranks. These observations suggest that the procedure is not greatly sensitive to changes from Maclean's weights. However, we are not certain that Maclean's has chosen the proper weights. Indeed, we feel that no single set of weights is correct as the choice depends on how the rankings are to be used. If the purpose of the rankings is to help individuals to make personal choices, then clearly each individual should be encouraged to use a "personal" set of weights that reflects his/her values. If the purpose is to summarize the views of a large group of people, one could average the "personal" weights of the entire population (or a representative sample) to obtain weights that could be argued as being correct. But how should one average the weights across the population? Should the weights of a high school student applying for university be averaged with the weights of someone returning to school after years in the workforce? We feel that the most appropriate approach is to define stakeholder groups and produce rankings for each of these groups. To this end, proper surveys would need to be conducted to assess the values (weights) held by different stakeholder groups.

Appendix

A.1 Maclean's Rankings on the 22 Quality Indicators

The rankings reported in the 1998 edition of Maclean's rankings on each of the 22 quality indicators are shown in Table A.1. The schools are presented in order of overall rank from best to worst.

A.2 Data Sources

Our main source of data consisted of a spreadsheet supplied by the Office of the President at UBC. The information on this spreadsheet was collated originally by the AUCC from data submitted by each participating university for the 1998 edition. The spreadsheet contained 82 columns of data (see Table A.2 for variable names) which served as the basis for computing the scores for the quality indicators. Where possible, we used the descriptions provided in the Maclean's article to determine how the indicator scores were calculated from the spreadsheet data. Table A.3 displays the formulas that we used. These computed scores were then verified against the scores in the Maclean's article.

For indicators Q12 and Q13, the article did not provide the weights of the two components used to generate the scores. By using equal weights on the standardized component values, we obtained rankings that matched the article. The spreadsheet did not contain any data concerning indicators Q6, Q11, and Q12 and we were unable to ascertain the appropriate formula for computing Q14. Hence for these 4 indicators we used the scores (ranks for Q22) from the article.

We noted several inconsistencies/omissions in the data which were corrected as follows:

- Dalhousie, variable V_{25}: the missing value was replaced by 1424, an interpolated estimate back-calculated from the ranks on indicator Q2
- Toronto, variable V_{10}: the value appeared to be incorrect and was replaced by 4994, a back-calculated value using the scores on indicator Q3
- UBC, variable V_{43}: the value was increased by 6 to match the value given in the article
- Calgary, variable V_{60}: the value was changed to \$994116 to match the value given in the article
- Manitoba, variable V_{63}: the value was changed to 279 to match the value given in the article
- in a number of cases, a missing value was replaced by 0 when deemed appropriate

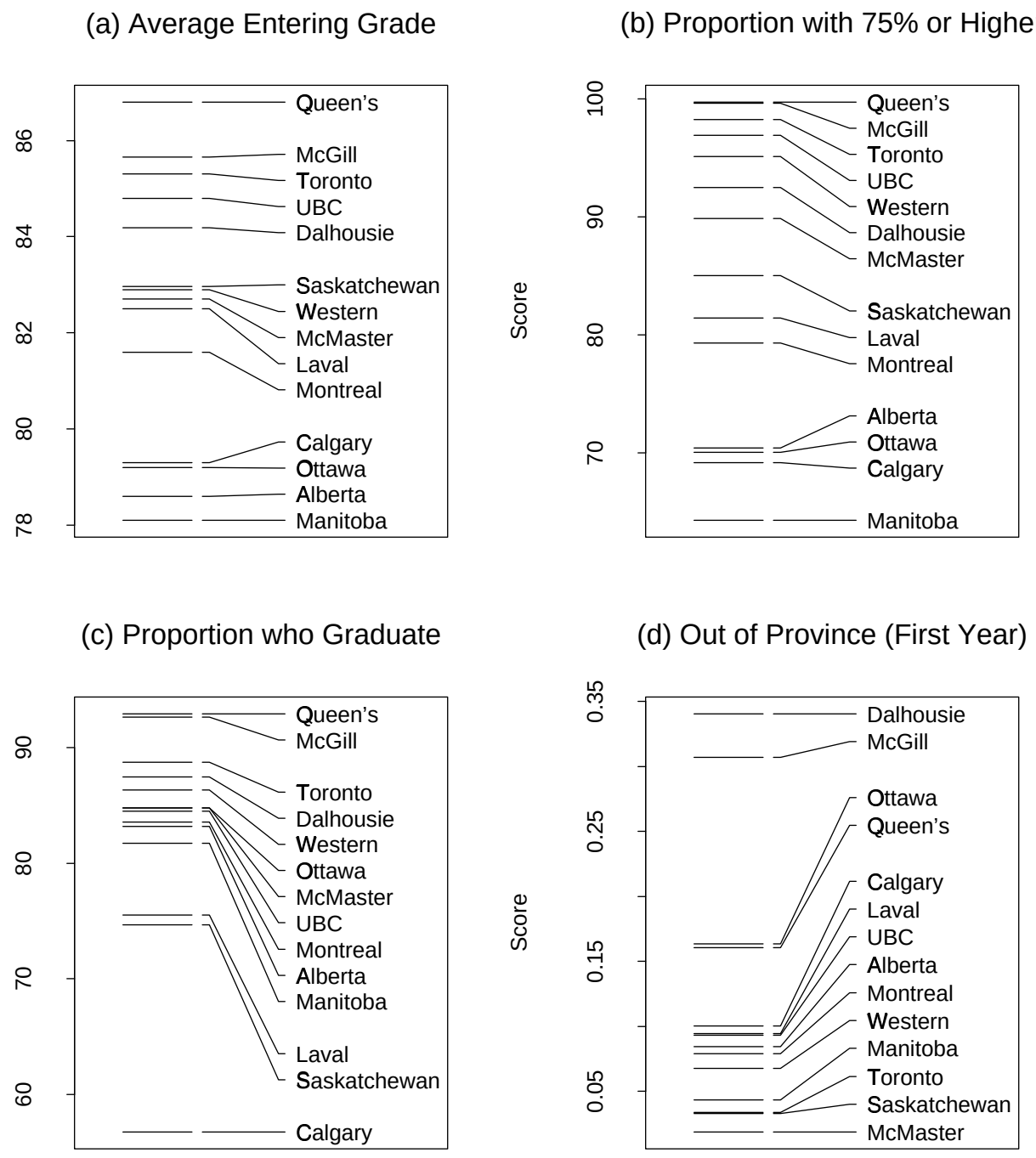


Figure 1: Plots of the underlying raw scores for each indicator.

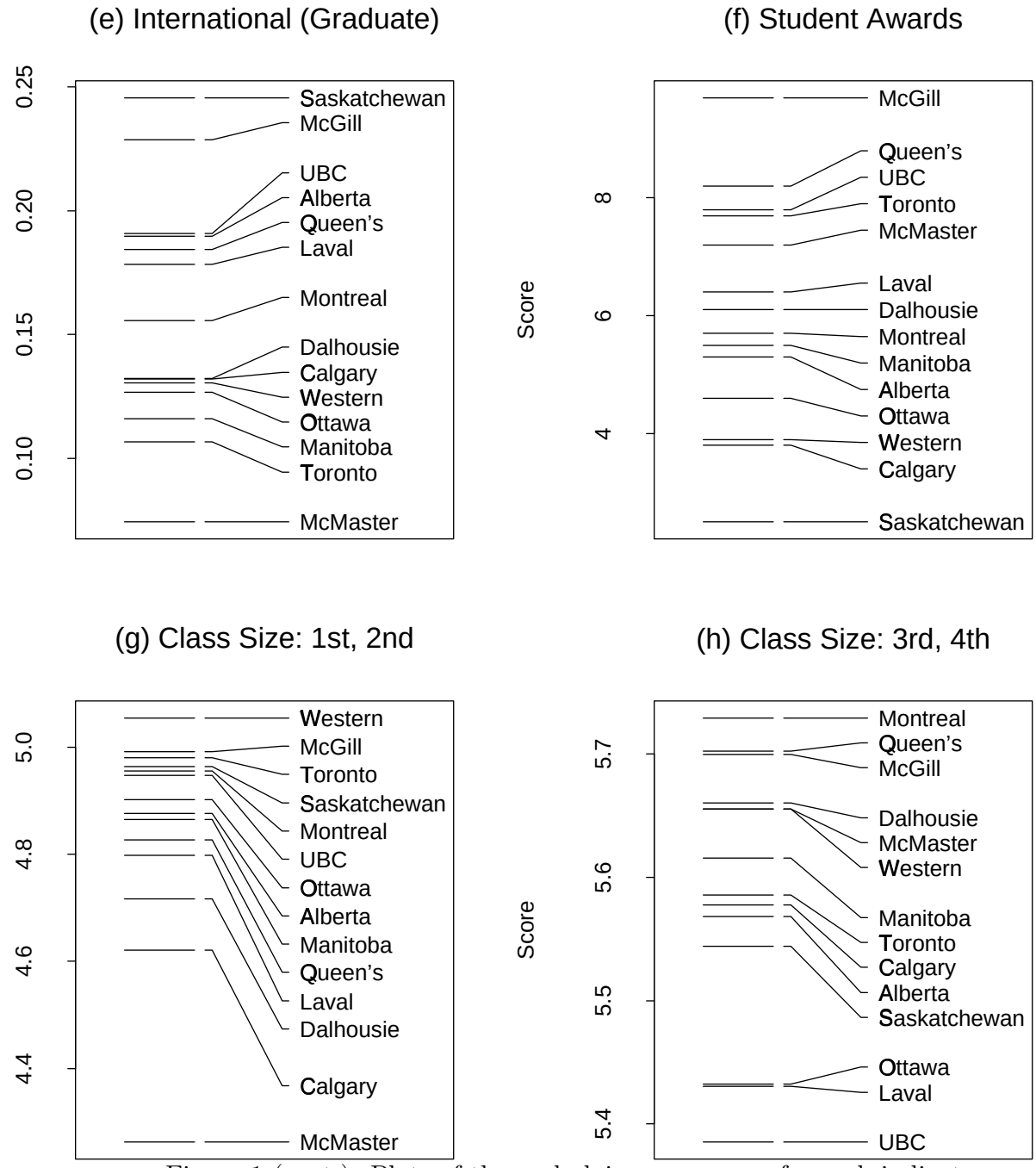
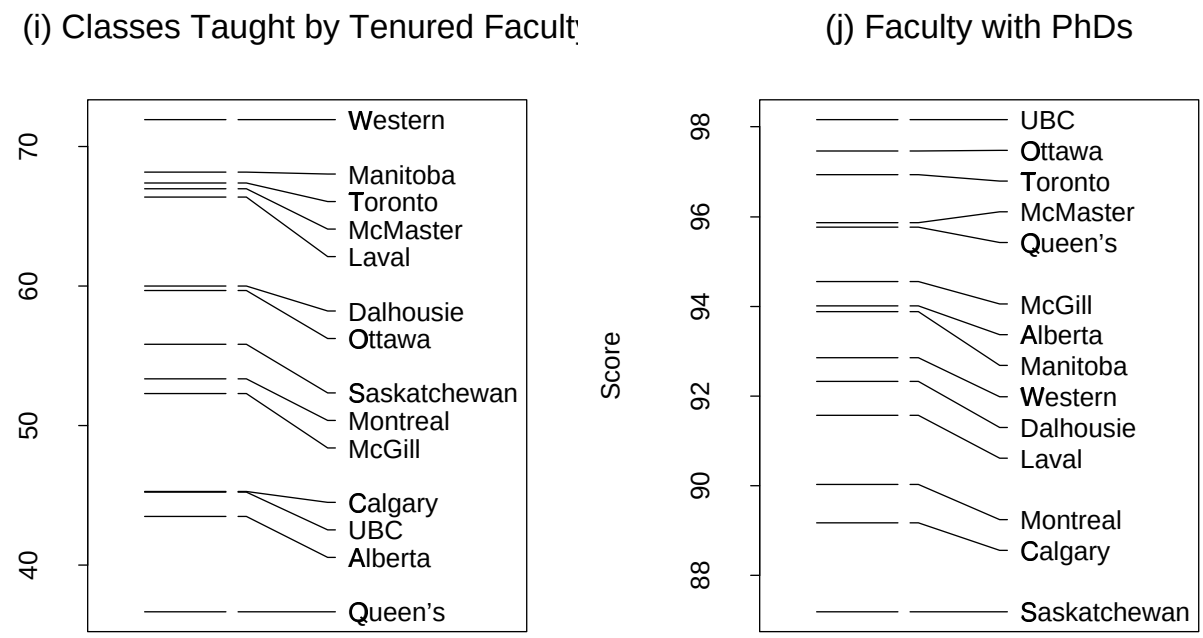


Figure 1 (cont.): Plots of the underlying raw scores for each indicator.



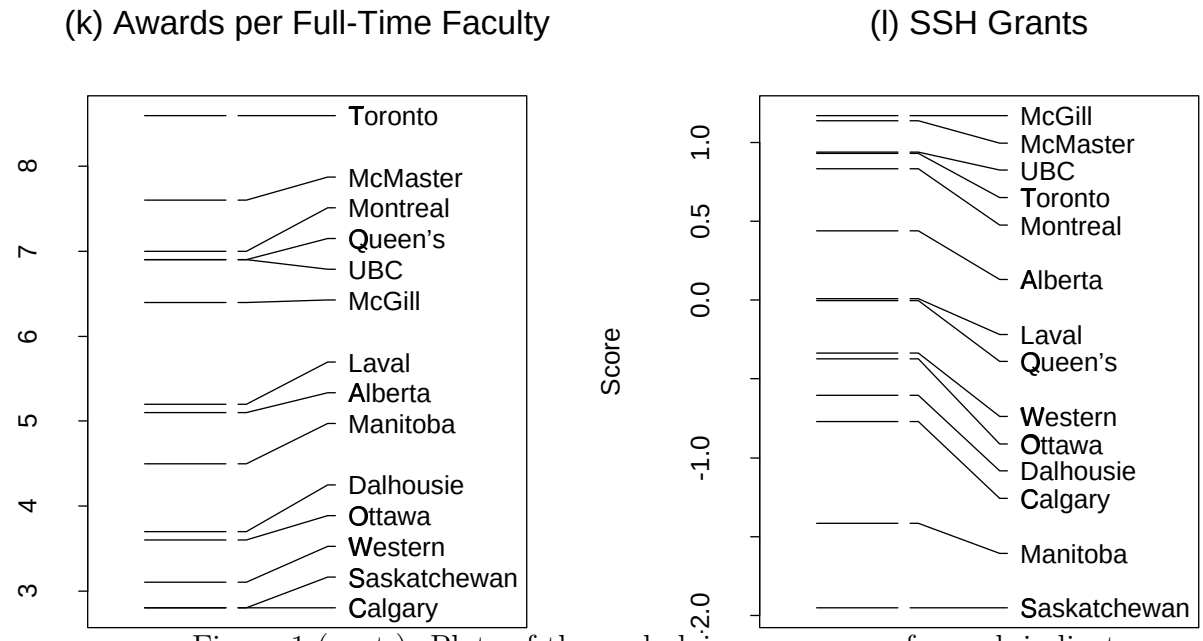
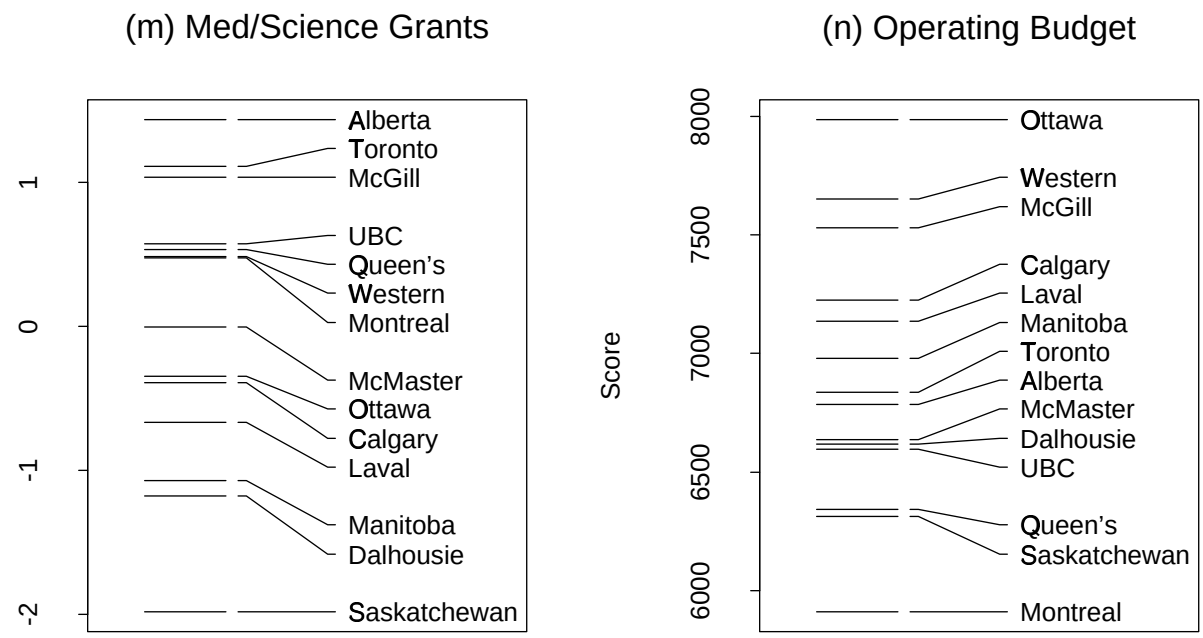


Figure 1 (cont.): Plots of the underlying raw scores for each indicator.



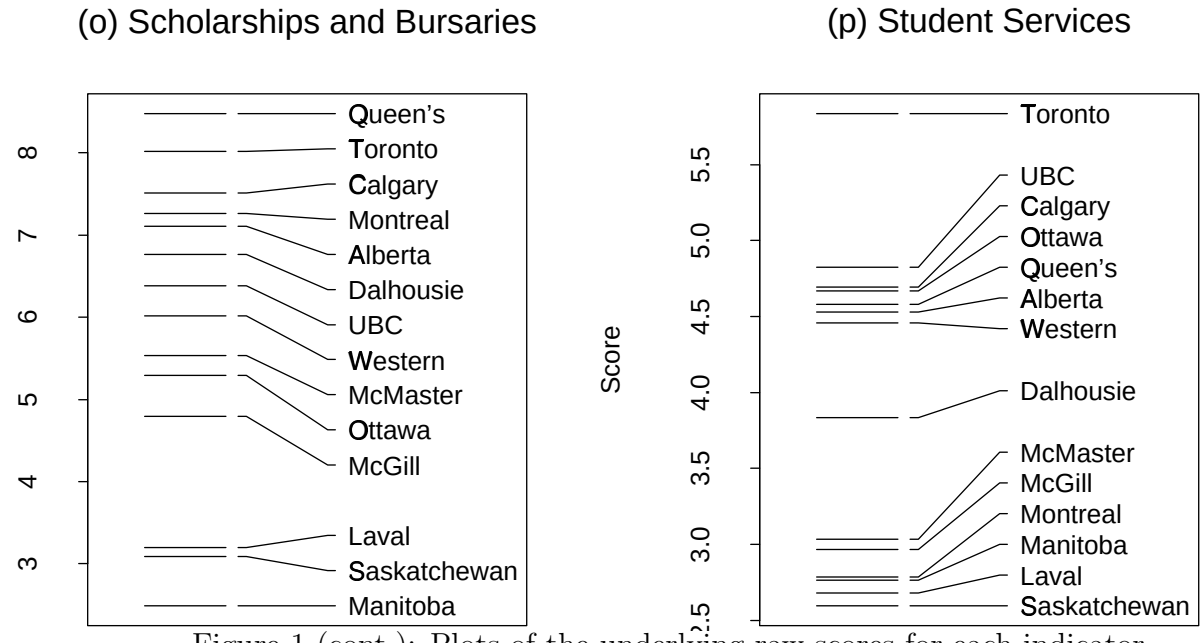
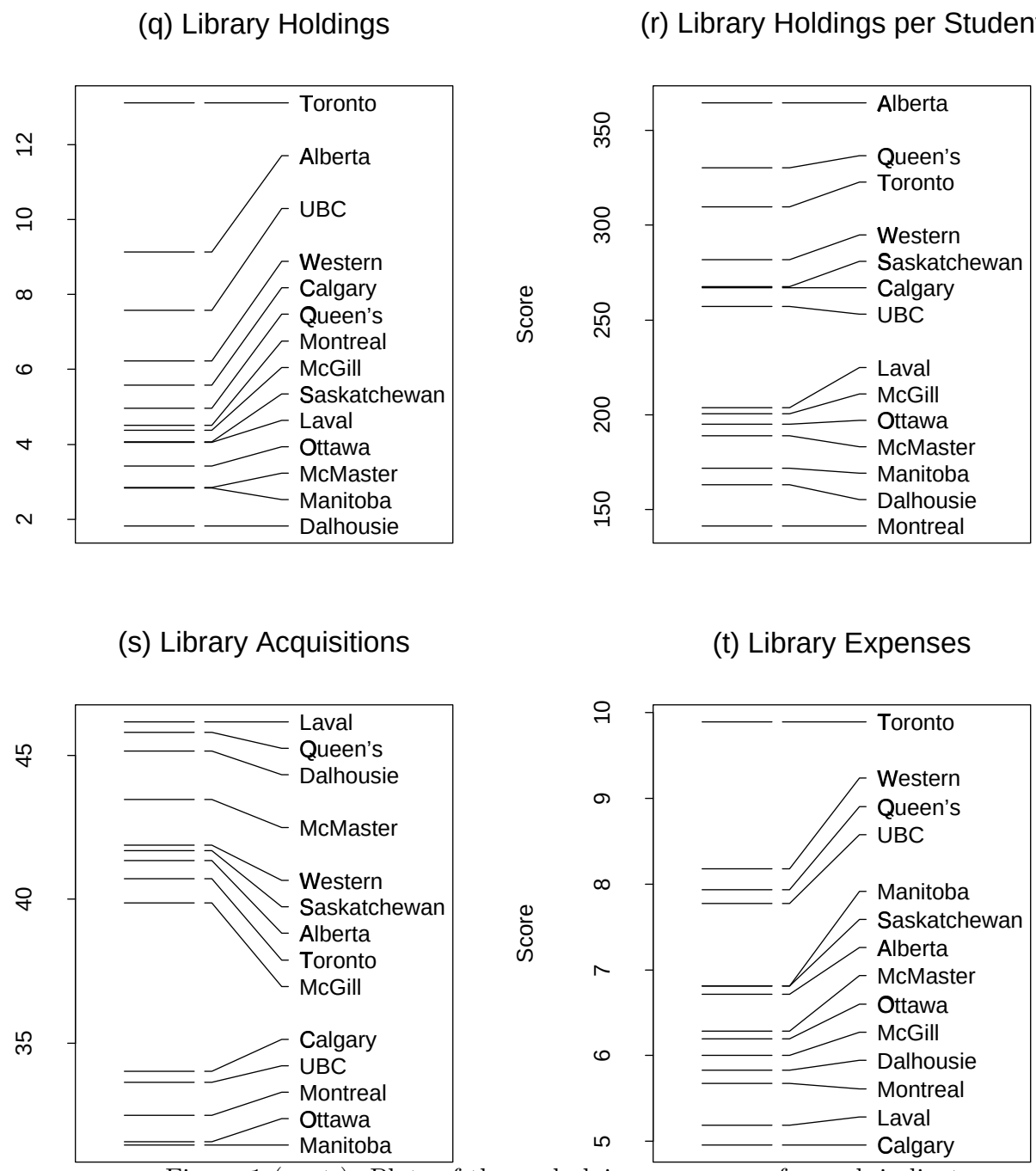


Figure 1 (cont.): Plots of the underlying raw scores for each indicator.



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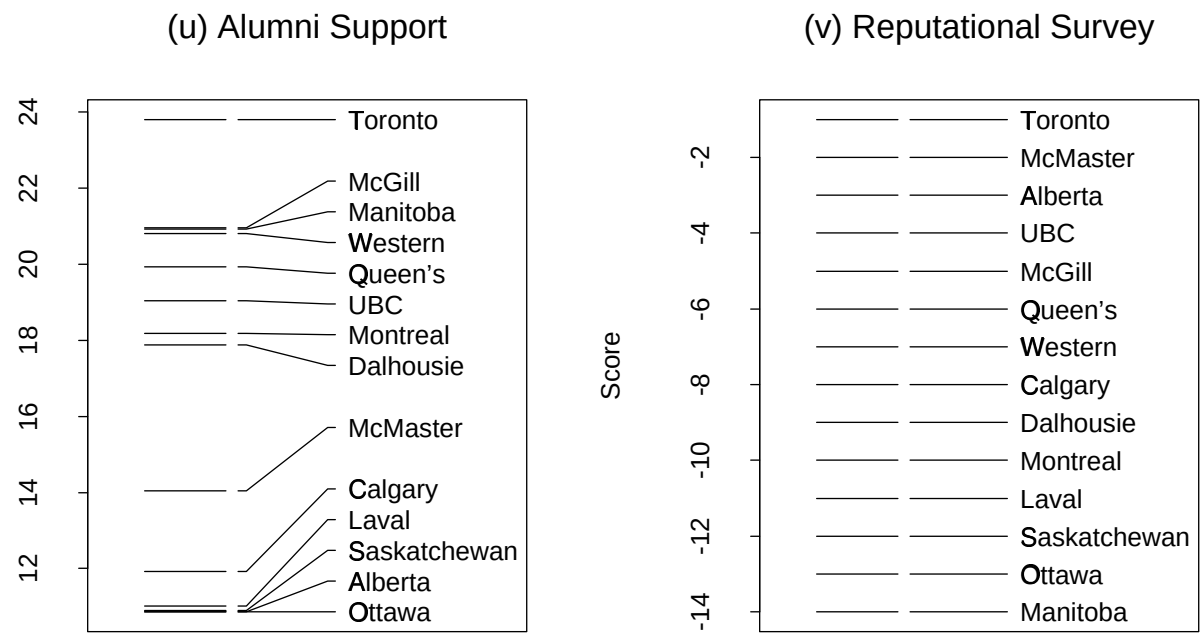


Figure 1 (cont.): Plots of the underlying raw scores for each indicator.

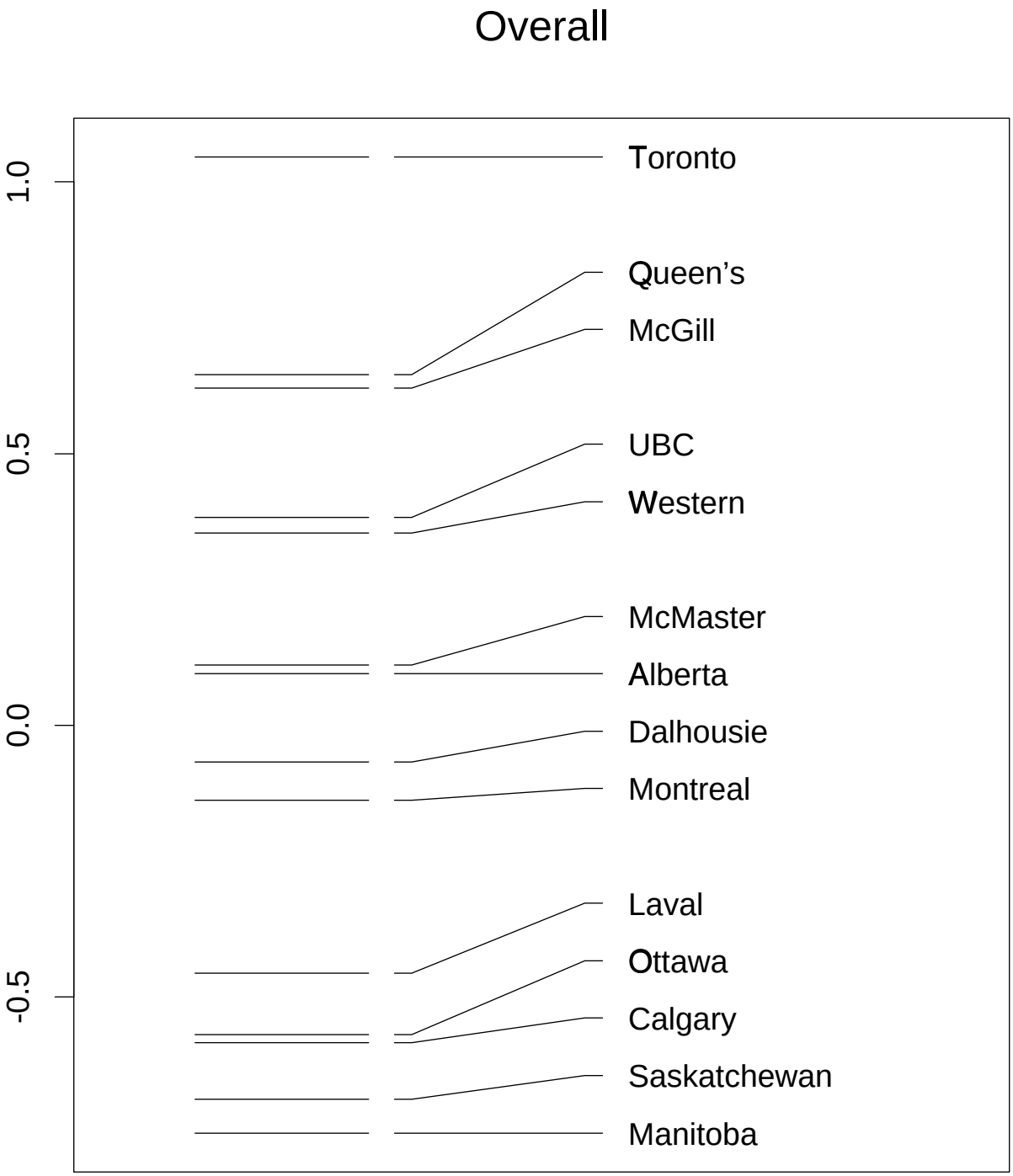


Figure 2: Plot of the overall raw scores.

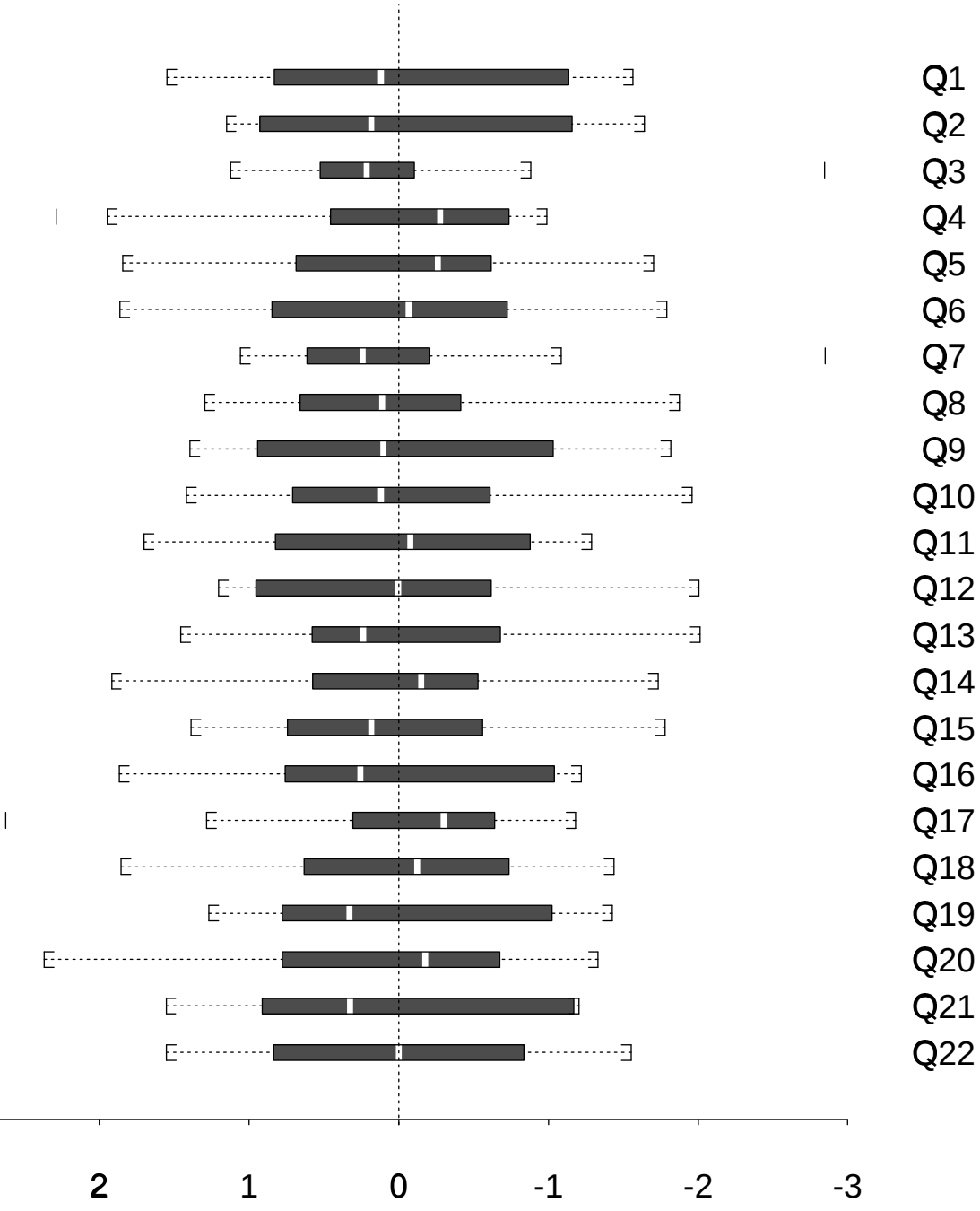


Figure 3: Boxplots of the standardized scores for each indicator.

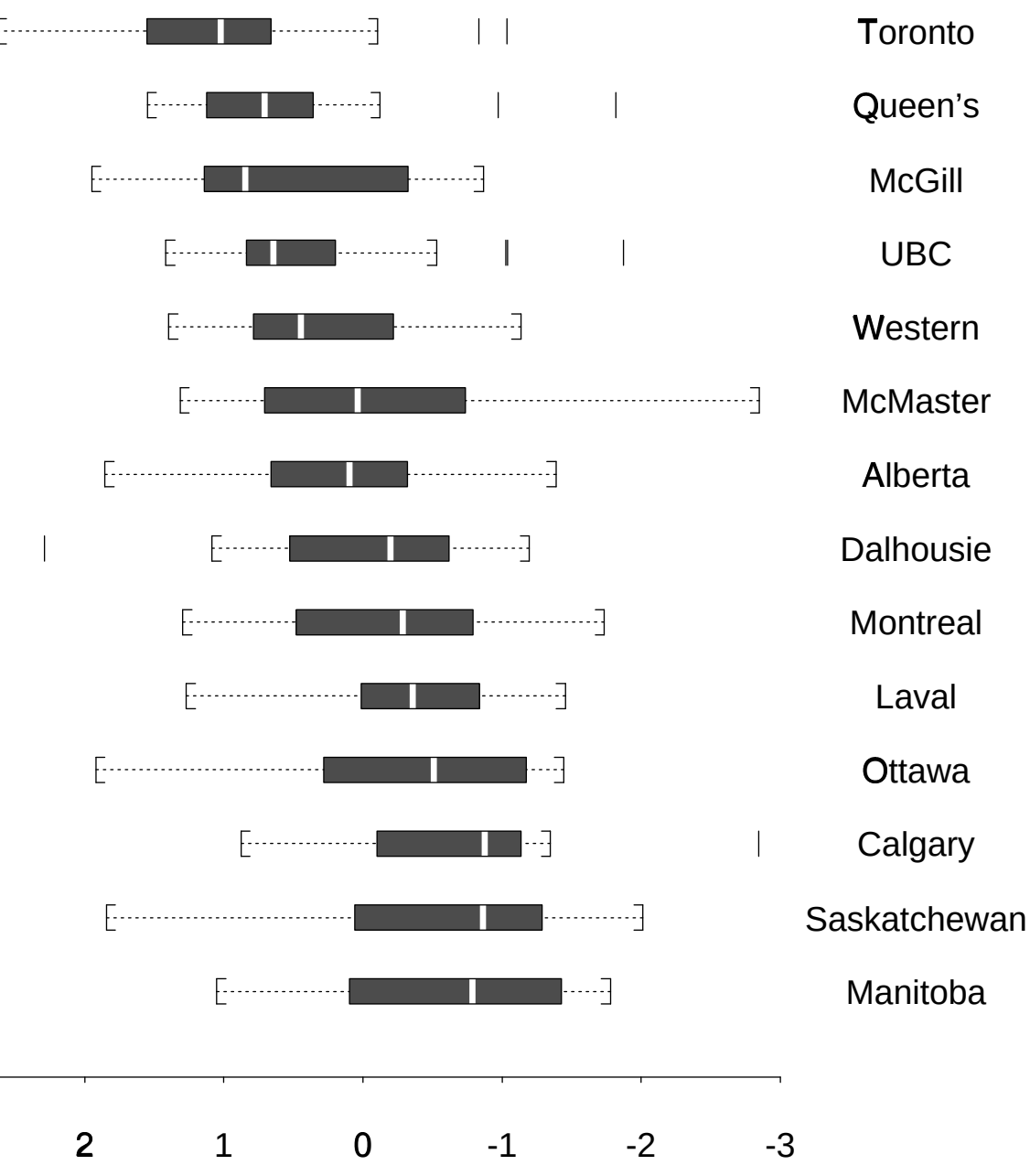


Figure 4: Boxplots of the standardized scores for each school.

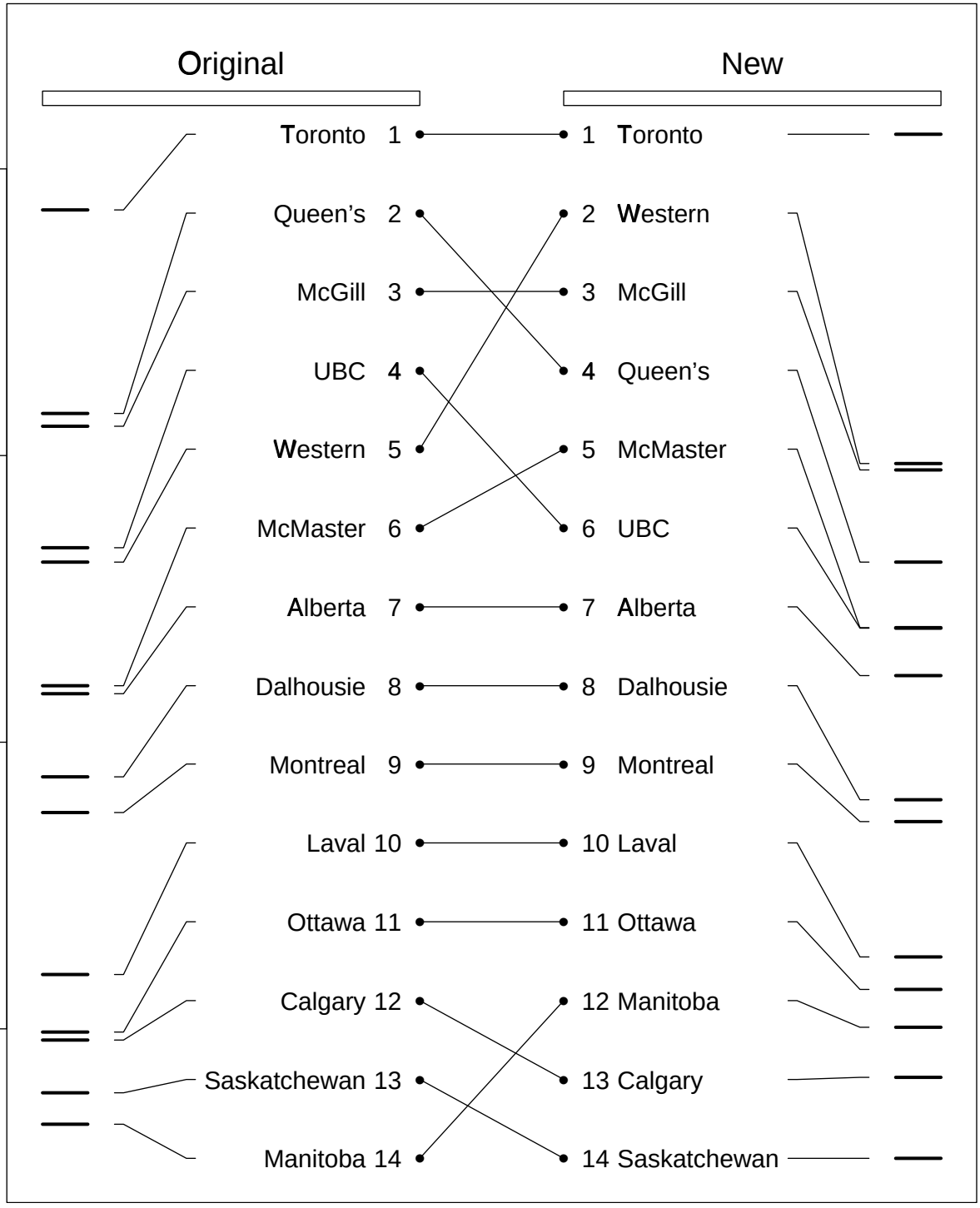


Figure 5: Change in overall ranking/scores when a 10% weight is transferred from the indicator 'Average Entering Grade' to the indicator 'Classes Taught By Tenured Faculty'.

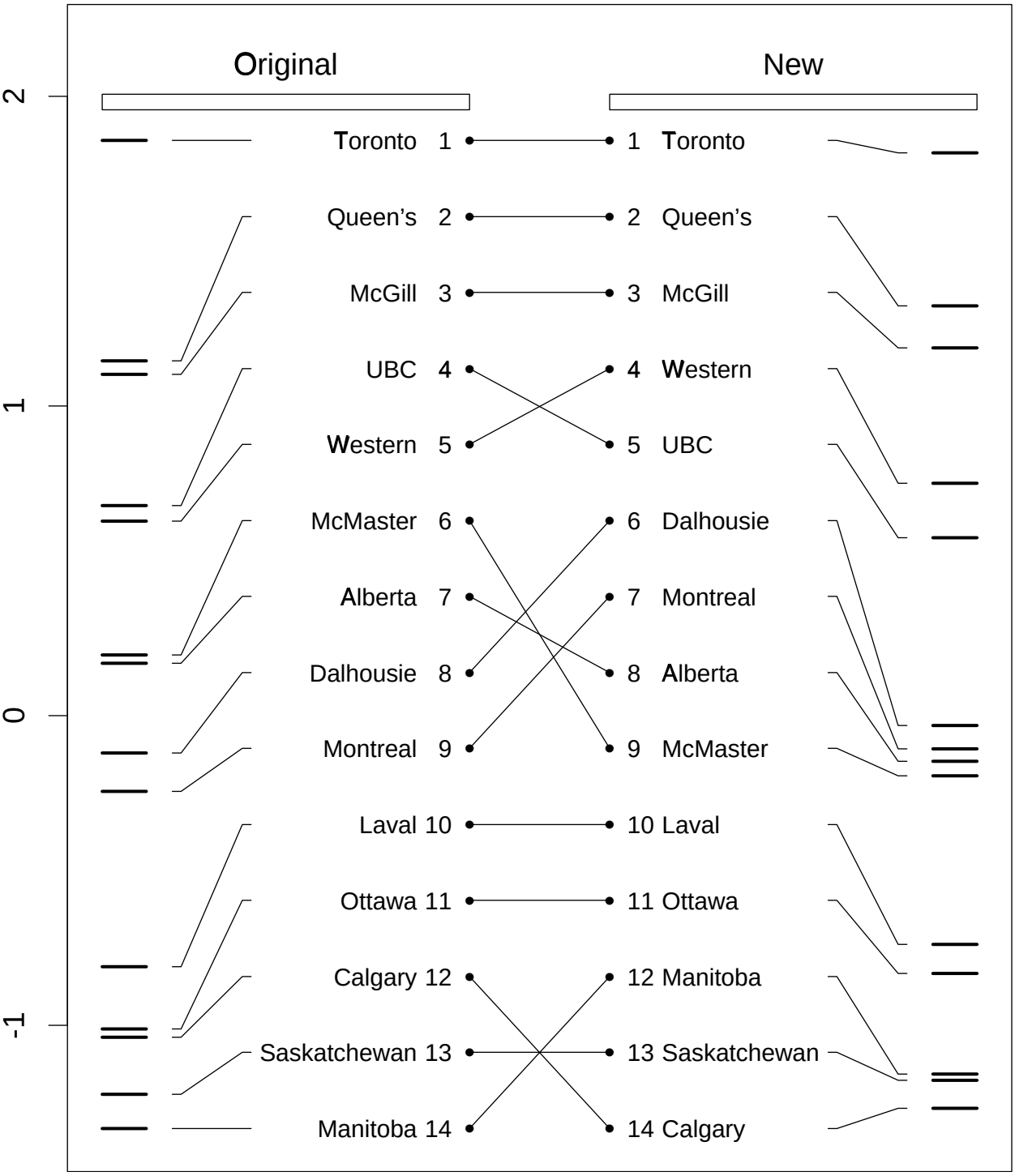
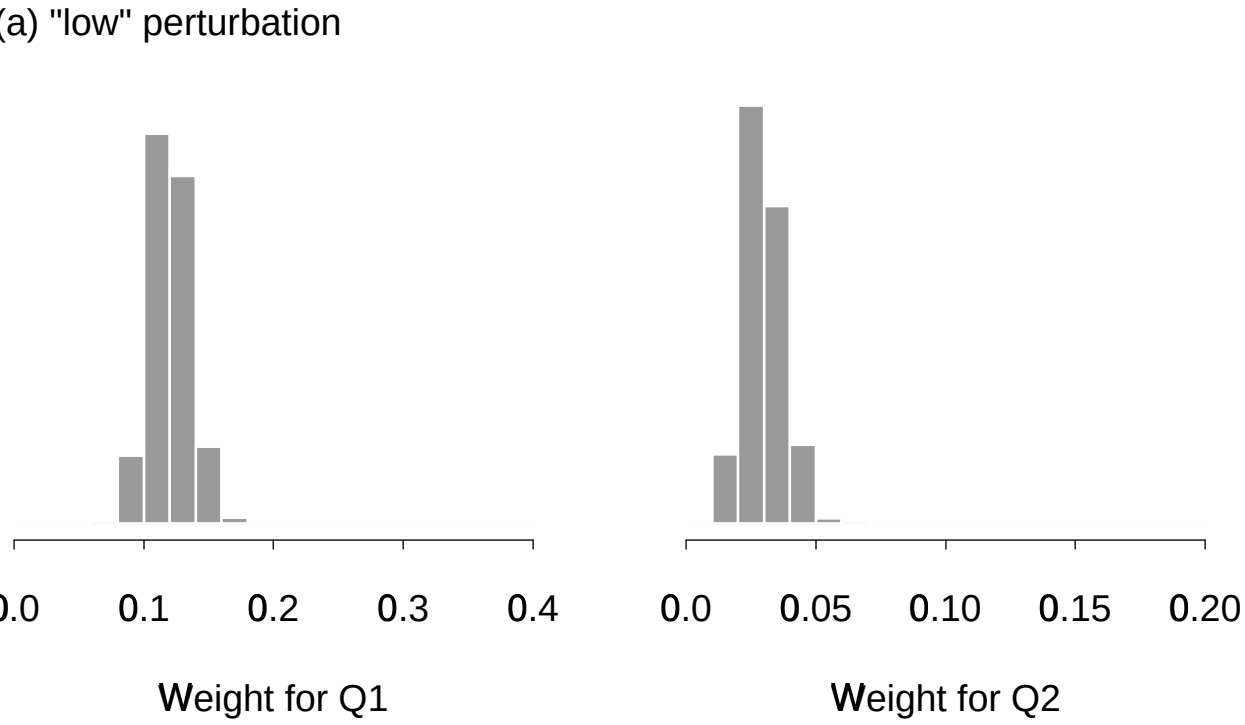


Figure 6: Change in overall ranking/scores when the indicator 'Reputational Survey' is excluded.



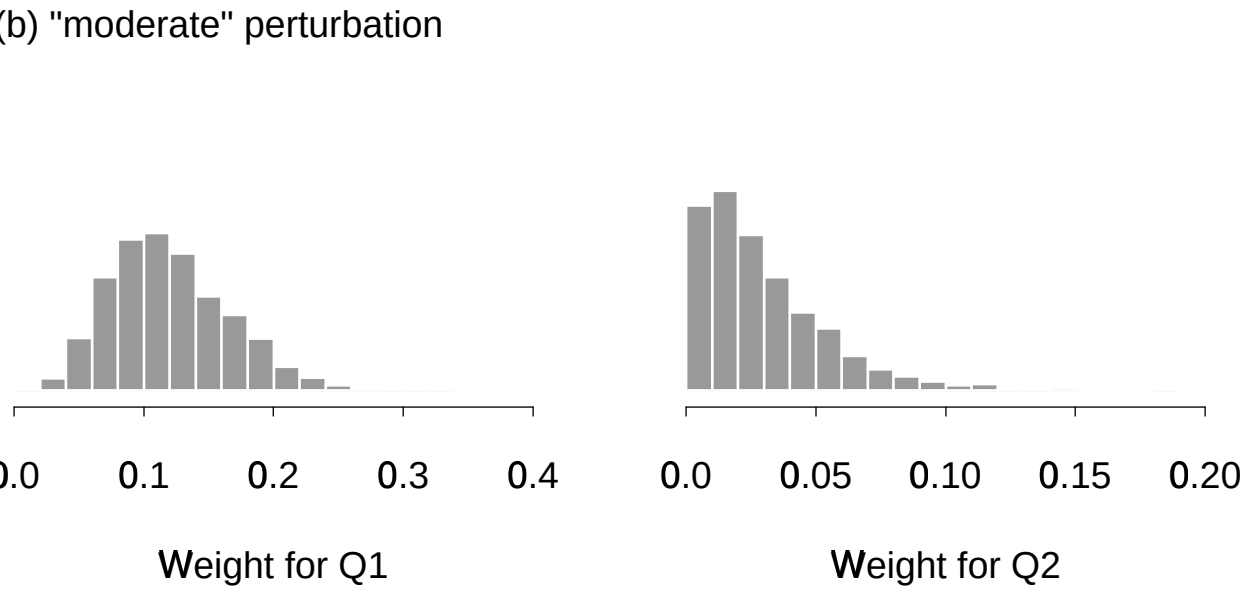


Figure 7: Histograms of the random weights for the first 2 indicators (Q1='Average Entering Grade', Q2='Proportion With 75% or Higher') for "low" and "moderate" perturbation levels.

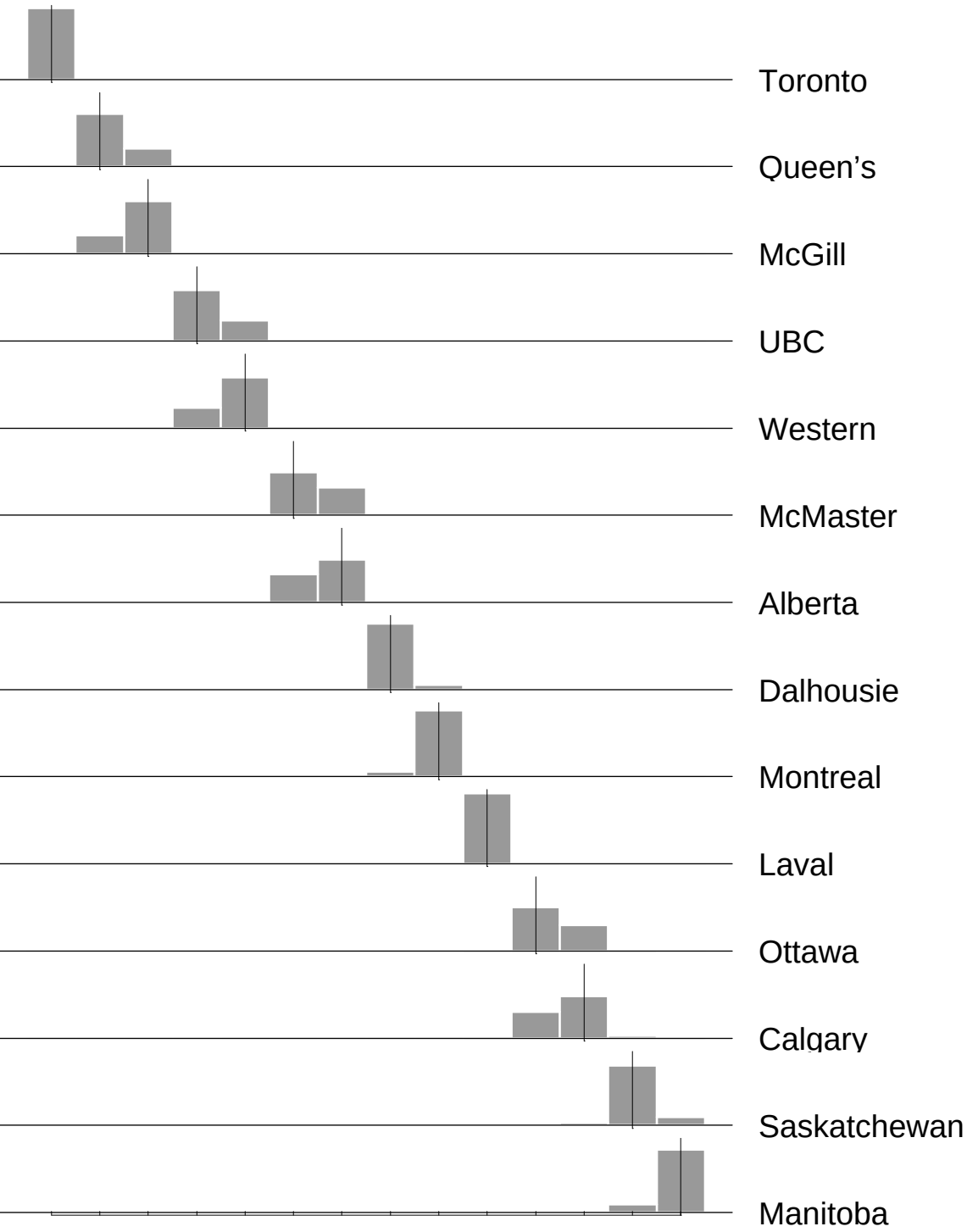


Figure 8: Histograms of simulated overall ranks when the weights have been randomly perturbed at the "low" dispersion level. (Noise has not been added to the quality indicator values.)

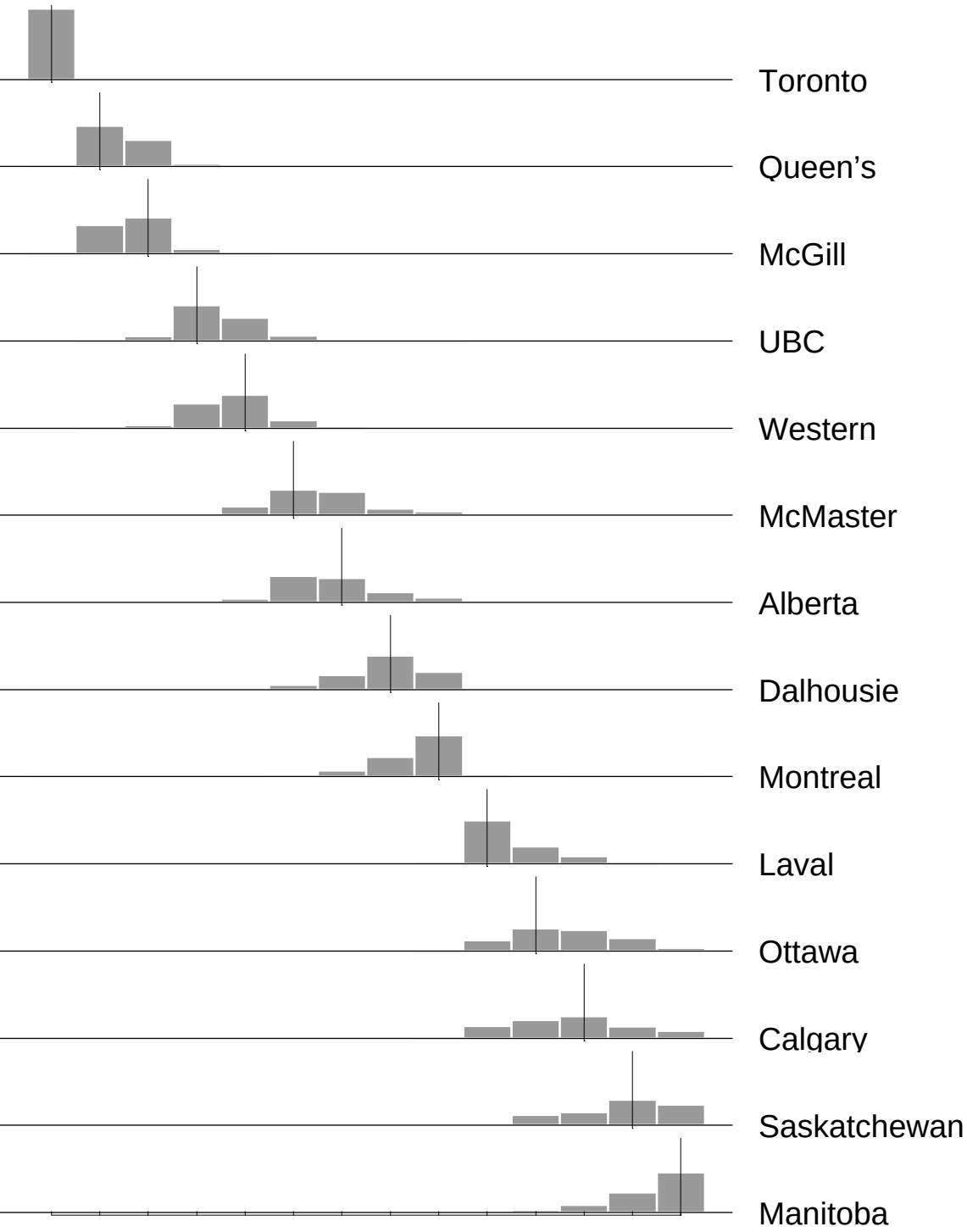


Figure 9: Histograms of simulated overall ranks when the weights have been randomly perturbed at the "moderate" dispersion level. (Noise has not been added to the quality indicator values.)

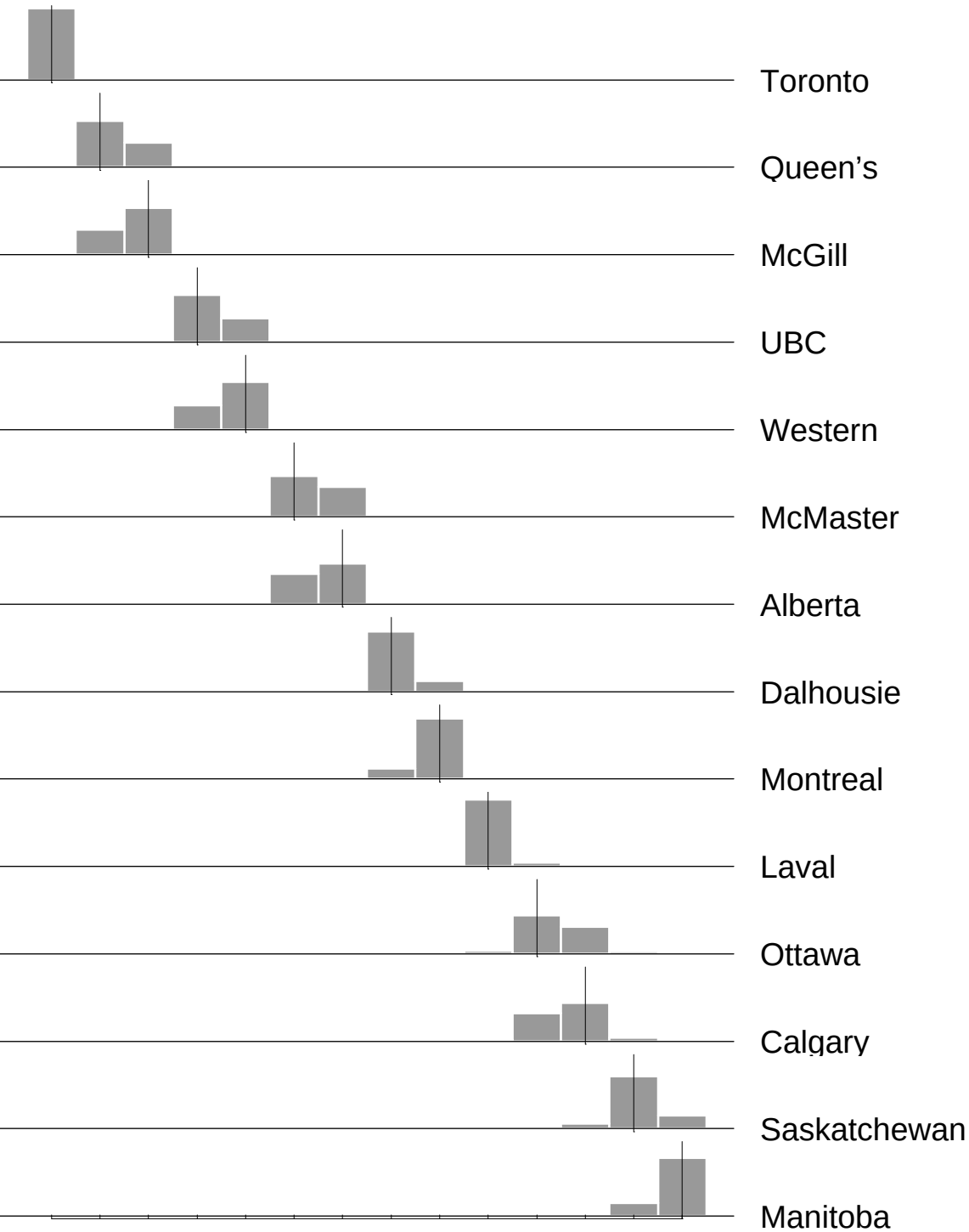


Figure 10: Histograms of simulated ranks when noise has been added to the values of the quality indicators. (Original weights used.)

Table A.1. Maclean's rankings on the 22 quality indicators. Schools are listed in order of the overall ranking (#1 = Toronto, #15 = Manitoba).

	Toronto	Queen's	McGill	UBC	Western	McMaster	Alberta	Dalhousie	Montreal	Laval	Ottawa	Calgary	Saskatchewan	Sherbrook	Manitoba
Average Entering Grade	3	1	2	4	7	8	14	5	11	9	13	12	6	10	15
Proportion With 75% or Higher	3	1	2	4	5	7	12	6	11	10	13	14	9	8	15
Proportion Who Graduate	3	1	2	8	5	7	10	4	9	12	6	15	13	14	11
(1st Yr) Out of Province	12	4	2	7	10	15	8	1	9	6	3	5	13	14	11
International (Graduate)	14	5	2	3	10	15	4	8	7	6	11	8	1	12	13
Student Awards	4	2	1	3	13	5	10	7	8	6	11	14	15	12	9
Class Sizes: 1st & 2nd Year	4	11	3	7	2	15	9	13	5	12	8	14	5	1	10
Class Sizes: 3rd & 4th Years	8	2	2	15	4	4	10	4	1	14	12	9	11	12	7
Classes Taught by Tenured Faculty	3	15	10	12	1	4	13	6	9	5	7	11	8	14	2
Faculty With PhDs.	3	5	6	1	9	4	7	10	12	11	2	13	14	15	8
Awards per Full-time Faculty	1	4	6	4	13	2	8	11	3	7	12	14	14	9	10
Social Sciences & Humanities Grants	3	8	1	3	9	2	6	11	5	7	10	12	15	14	13
Medical/Science Grants	2	5	3	4	6	8	1	13	7	11	9	10	15	14	12
Operating Budget	7	12	3	11	2	9	8	10	14	5	1	4	13	15	6
Scholarships & Bursaries (% of Budget)	2	1	11	7	8	9	5	6	4	12	10	3	13	15	14
Student Services (% of Budget)	1	5	11	2	7	10	6	8	12	14	4	3	15	9	13
Total Holdings	1	6	8	3	4	12	2	14	7	10	11	5	9	15	13
Holdings per Student	3	2	8	7	4	11	1	13	14	9	9	5	5	15	12
Library Acquisitions	9	3	10	12	6	5	8	4	13	2	14	11	7	1	15
Library Expenses	1	3	10	4	2	8	7	11	12	13	9	14	5	15	5
Alumni Support	1	5	2	6	4	10	13	8	7	12	13	11	13	9	3
Reputational Survey	1	6	5	4	7	2	3	9	11	12	14	8	13	10	15

Table A.2. List of variables in the source data file.

V_1	Category	V_2	FT Year 1 Students
V_3	Out of Province Ug	V_4	FT Graduates
V_5	International Grad	V_6	FT Year 1 1991 92
V_7	FT Year 1992 93	V_8	FT Year 2-3Yr, 1992 93
V_9	Graduated by 1995	V_{10}	FT Year 2-4Yr, 1992-93
V_{11}	Graduated by 1996	V_{12}	FT Year 2-5Yr, 1992-93
V_{13}	Graduated by 1997	V_{14}	FT Undergrad 1992-96
V_{15}	FT Undergrad 1992-96 (excl Int'l)	V_{16}	FT Graduate 1992-96
V_{17}	FT Graduate 1992-96 (excl Int'l)	V_{18}	Sec School CEGEP
V_{19}	FTE Arts Social Sci.	V_{20}	FTE Sciences
V_{21}	FTE Professional	V_{22}	FTE 2nd Entry Professional
V_{23}	FTE Visual Perf. Arts	V_{24}	FTE Masters
V_{25}	FTE Doctoral	V_{26}	FT Doctoral
V_{27}	PT Doctoral	V_{28}	FTE Med Dent Opt Vet
V_{29}	FTE Unclassified	V_{30}	FTE Undergraduates
V_{31}	FTE Graduates	V_{32}	Grade Avg of FT Year 1
V_{33}	FT Year 1 $\geq$ 75.	V_{34}	Standard Deviation
V_{35}	FT Faculty	V_{36}	FT Professorial Ranks
V_{37}	FT Faculty 1992 96	V_{38}	PhD or Doctorate
V_{39}	FT CC SSHRC Faculty	V_{40}	FT NSERC Faculty
V_{41}	FT MRC Faculty	V_{42}	Year 1 Classes
V_{43}	Yr12 1-25 students	V_{44}	Yr12 26-50 students
V_{45}	Yr12 51-100 students	V_{46}	Yr12 101-250 students
V_{47}	Yr12 251-500 students	V_{48}	Yr12 more than 500 students
V_{49}	Yr12 total number of classes	V_{50}	Yr12 One on one classes
V_{51}	Yr34 1-25 students	V_{52}	Yr34 26-50 students
V_{53}	Yr34 51-100 students	V_{54}	Yr34 101-250 students
V_{55}	Yr34 251-500 students	V_{56}	Yr34 more than 500 students
V_{57}	Yr34 total number of classes	V_{58}	Yr34 One on one classes
V_{59}	Year 1 taught by T TS	V_{60}	CC SSHRC Grant
V_{61}	Num of CC SSHRC Grants	V_{62}	NSERC Grant
V_{63}	Num of NSERC Grants	V_{64}	MRC Grant
V_{65}	Num of MRC Grants	V_{66}	Operating Expenditures
V_{67}	Exp for Scholr Bursaries	V_{68}	Exp for Student Services
V_{69}	Exp for Libraries	V_{70}	Exp for Library Acq
V_{71}	Monograph volumes	V_{72}	Serial volumes
V_{73}	Documents Tech Reports	V_{74}	Micromaterials
V_{75}	Total Holdings	V_{76}	Alumni 1992-97
V_{77}	who gave 1992-97	V_{78}	FT Year 1 Students
V_{79}	FT Undergrad Students	V_{80}	FT Graduate Students
V_{81}	PT Students	V_{82}	Undergrad Tuition 1998-99

Table A.3. Formulas and weights for the 22 quality indicators.

Label	Weight (%)	Quality Indicator		Formula
		Student Body (21% to 22%)		
Q1	12	Average Entering Grade	=	V_{32}
Q2	3	Proportion With 75% or Higher	=	$100\% \times V_{33}/V_{18}$
Q3	1	Proportion Who Graduate	=	$100\% \times \frac{V_9+V_{11}+V_{13}}{V_8+V_{10}+V_{12}}$
Q4	1	Out of Province (1st Year)	=	$100\% \times V_3/V_2$
Q5	1	International (Graduate)	=	V_5/V_4
Q6	2	Student Awards	=	use the article values
		Classes (17% to 18%)		
Q7	7	Class Sizes: 1st And 2nd Year	=	$\begin{pmatrix}6V_{43}+5V_{44}+4V_{45}\\+3V_{46}+2V_{47}+V_{48}\end{pmatrix}/V_{49}$
Q8	7	Class Sizes: 3rd And 4th Year	=	$\begin{pmatrix}6V_{51}+5V_{52}+4V_{53}\\+3V_{54}+2V_{55}+V_{56}\end{pmatrix}/V_{57}$
Q9	3	Classes Taught by Tenured Faculty	=	$100\% \times V_{59}/V_{42}$
		Faculty (17%)		
Q10	3	Faculty With PhDs.	=	$100\% \times V_{38}/V_{35}$
Q11	3	Awards per Full-time Faculty	=	use the article values
Q12	5.5	SSHRC/CC Grants	=	$\mathcal{S}(V_{60}/V_{39})/2 + \mathcal{S}(V_{61}/V_{39})/2$
Q13	5.5	MRC/NSERC Grants	=	$\mathcal{S}\left(\frac{V_{62}+V_{64}}{V_{40}+V_{41}}\right)/2 + \mathcal{S}\left(\frac{V_{63}+V_{65}}{V_{40}+V_{41}}\right)/2$
		Finances (12%)		
Q14	3.3	Operating Budget	=	use values from the article
Q15	4.3	Scholar. & Bursaries	=	$100\% \times V_{67}/V_{66}$
Q16	4.3	Student Services	=	$100\% \times V_{68}/V_{66}$
		Library (12%)		
Q17	1	Total Holdings	=	$V_{75}/1000000$
Q18	3	Holdings per Student	=	$V_{75}/(V_{30}+V_{31})$
Q19	4	Acquisitions	=	$100\% \times V_{70}/V_{69}$
Q20	4	Expenses	=	$100\% \times V_{69}/V_{66}$
		Reputation (20%)		
Q21	5	Alumni Support	=	$100\% \times V_{77}/V_{76}$
Q22	15	Reputational Survey	=	use the article ranks
$\mathcal{S}(x)$ means the standardized value of x Weights shown are for Medical/Doctoral schools				