Academic Inbreeding at the Canadian Engineering Schools

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Abstract. Academic inbreeding is a label used when units, departments and universities hire their former students, predominantly their former Ph.D. students, as faculty members, a practice that is generally perceived as detrimental to academic productivity and diversity. In this paper, for the first time, we attempt to verify some of the reported attributes for a small sample of Canadian universities, namely for the largest engineering schools. We examined more than 60 departments and units at 11 universities. We show that academic inbreeding is in fact present at the investigated units with a national average of 23%. Twelve departments exhibited a Z-score of one (inbreeding index larger than 34%, four departments showed a Z-score score of almost 2 and higher (inbreeding index larger than 44%). As well, we demonstrate that the quality of publications, measured by the number citations, appears to be lower for the inbreds. We also introduce a new measure that seems to be more suitable to capture the negative effect of inbreeding on diversity.

1 Introduction

There has been no investigations on the phenomenon of academic inbreeding at Canadian universities, its spread and effects. This is quite strange as there are many reports on some Russian, Spanish, Japanese, Portuguese, Australian, Ukrainian universities that struggle with excessive inbreeding (e.g., see [21, 16, 2]). There are also a wealth of papers on inbreeding in United States [15, 18]. Why Canada has been an exception is certainly not because of inbreeding does not exist at the Canadian universities. As we will report later, inbreeding is an existing phenomenon at the Canadian universities. Perhaps this has more to do with the fact that Canada is a young country with many comparably new universities that only in recent years have received an influx of diverse academic talent from abroad but still continue to maintain hiring former students for some reason.

In this preliminary work, we only focus on a subset of universities mainly because of our experience with engineering schools. The objective of this paper is twofold: First, we look at (large) Canadian engineering schools as a sample to find out whether inbreeding is present in Canada in any way that according to general body of literature, it could be perceived as excessive. Second, we would

like to find the relationship between the inbreeding and quality of the publications in terms of citations. Most studies focus on number of publications instead of examining whether inbreds are more or less productive. But since in our experience the academic excellence is a frequently used argument to hire inbreds (“we only hire the best”), it appears that citations may be a more expressive feature, especially because the literature on inbreeding generally agrees on the lower productivity of inbreds.

2 Literature Review

As there is no work on academic inbreeding at Canadian universities, we recognize the need to review the literature to establish some general understanding of the subject matter. The literature on this subject is more than a century old and it widely regards inbreeding as a detrimental phenomenon, among others towards academic productivity and networking [13]. Charles Eliot, the President of Harvard University warned in 1908 that it may be natural, but certainly not wise, for universities to recruit their faculties mainly from their former students [6]. Eliot argued that former students are well known to the hiring committees and their hiring may be more convenient but it is unwise because “breeding in” faculty members has “grave dangers for a university” [6]. Eliot believed that proponents of inbreeding may propose many “natural” reasons to hire former students, paucity of applicants and alleged excellence of former students being two most widely used ostensible reasons. More than 80 years ago, McNeely also expressed his concerns that employing large numbers of former students as faculty members is “detrimental to the efficiency and progress of institutions of higher education” [15], and pointed to “graduates” in general and not just to Ph.D. graduates. The phrase “*large numbers of their own graduates*” has remained somewhat subject to interpretation, something that may be misused to justify excess of inbreeding at some institutions. Shouan Pan (1993) states in his extensive doctoral thesis on academic inbreeding that examined 11 land-grant universities that both supporters and opponenets of inbreeding “agree that excessive inbreeding is harmful to an academic institution” [18].

To measure inbreeding, one has to define who can be regarded as an inbred. The taxonomy of academic career categories has grown to be become quite detailed; one distinguishes among “pure inbreds” (always at the same university), “mobile inbreds” (e.g., only a postdoc at another university), “silver-corded” (first job at another university), “adherents” (non-inbreds who moved only once), and “non-inbreds” (studied and worked at several universities) [10].

Comprehensive studies on inbreeding in many countries have been reported [23]. A major concern about inbreeding has always been their *low productivity*. Measured by looking at book publication, Eells and Cleveland found in 1953 that inbreds “published 864 books as compared with 1,122” for non-inbreds [5]. However, this perhaps does not mean that all inbreds have low scholarly outputs compared to non-inbreds; studies are mostly about the general trend and dominant features of the inbreeding as a phenomenon without excluding the

possibility that there are individual inbred faculty with high productivity. By examining the scholarly output of 3861 faculty members from 64 Mexican institutions, Horta et al. (2010) found that in fact academic inbreeding is detrimental to scientific productivity and concluded their results show excessive inbreeding “can easily lead to academic fossilization and knowledge atrophy” [12]. Examining Japanese post-secondary institutions, Horta et al. conclude that “the pursuit of the whole tertiary education experience within the same university is simultaneously a characteristic of academic inbreeding of the traditional tertiary education learning” and suggest to take actions in order to promote student mobility between institutions [11]. Examining the effect of inbreeding on the scholarly output of Turkish technical universities, Inanc and Tuncer examined the H-index distribution for both inbreds and non-inbreds and reported significantly higher H-index of non-inbreds. “The mean H-index for inbreds is 2.1, whereas it is 2.8 for non-inbreds. Therefore the H-index of non-inbreds is approximately 35% higher than their inbred colleagues on the average” [14]. This phenomenon has been observed at the Japanese universities as well [2].

Investigating the Australian law schools, Mishra and Smyth report “negative results” and report that there is no significant difference in the research performance of inbred and non-inbred staff, and argue, based on numerous published works, that inbreds are less productive based on “data from countries and disciplines in which the proportion of inbred staff is relatively high” [16]. A finding that may solidify the position that inbreeding is only detrimental if it occurs in excess.

Other aspects of inbreeding may not have been investigated properly yet. For instance, one can guess that perhaps the hiring process of faculty does not follow the usual fairness and integrity rules of universities when inbreds are hired. It has been found that “entering into academia and progressing further in an academic career” is “a matter of pure chance – the chance of having a supporter on a recruitment committee” [22]. Godechot and Louvet (2010) have shown that in France in the 1980s inbred PhDs could have seventeen times more chance of getting hired than outbred PhDs [8]. That constitutes a clear bias and systemic favouritism. Perhaps when such strong favouritism is displayed during the hiring process, the favouritism would continue to retrospectively vindicate the biased hiring decision. For instance, that probably will affect the objectivity of assigning teaching and research awards whenever the decision is entirely up to the unit and department, a potential effect of inbreeding that has not been investigated.

Most academic supervisors would argue that their former students have been outstanding. Many of them may be in favour of hiring their former student. Godechot identified “former PhD advisors as among the strongest potential sponsors, with an effect that can double or triple a candidate’s odds of being put forward” [7]. One may also look at “the potential existence of favoritism in academic promotions” as another effect of inbreeding and other types of “connections” and that such “prior connections with evaluators on the promotion committees affect the success rate of candidates” when promotions to full profes-

sors are being awarded [24]. From this perspective, inbreeding may be examined in context of career barriers for academics [19].

Of course, “mobility” or “immobility” at the early stages of a research career is immensely crucial in shaping the general attitudes in academia and the scholarly productivity whereas it must be obvious that nothing fundamentally changes when somebody changes institutions only once [9]; Inbreeding and academic immobility are often associated [1] whereas immobility is not strictly *a single-university career* but may have short-length sporadic experiences of other universities. Horta and Yudkevich [13] mention barriers to mobility outside academia such as rents of apartments as a constrain to mobility that seem to foster academic inbreeding although this may be hard to justify for most Canadian universities.

3 Inbreeding at Engineering Schools in Canada

There has been no systematic study of academic inbreeding at the Canadian universities. A thorough examination of a complex phenomenon like inbreeding requires country-wide investigation of most if not all universities. In 2016-2017, according to Statistics Canada, there were a total of 45,660 professors/instructors across all ranks³. The QS (Quacquarelli Symonds) Top Universities lists 26 universities in Canada⁴. As there has been no study on inbreeding at the Canadian universities, and as a comprehensive statistical account of Canadian inbreeding is outside the scope of this paper, we only deliver a sample case by looking at the largest Canadian engineering schools. The initial motivation was the observation of inbreeding and its perceived effects at some universities in Ontario and the total lack of literature to shed light on inbreeding in a Canadian context. It is quite strange that inbreeding at the Canadian universities has not been investigated yet.

To not make random selection, and to stay in consistency with “ranking-oriented” evaluation that universities themselves generally honour, we investigated the list of the top ten universities of the past two years and selected the intersection of the list for 2016 and 2017 which adds up to 11 engineering schools according to well-respected sources in Canada⁵. Within the selected engineering schools, there were 63 academic units (departments). We excluded three units that were too small (less than 10 members, some with cross appointments or adjunct positions). Hence, we examined 60 units at 11 large Canadian engineering schools. Table 1 provides the list of the units with assigned codes for more convenient representation.

3.1 Data Collection

We had two questions to clarify: is there academic inbreeding at engineering schools in Canada? and, how is the publication quality for both inbreds and non-

³ www.statcan.gc.ca

⁴ www.topuniversities.com

⁵ University Rankings for 2015 and 2016, MacLean’s magazine

Table 1. 60 departments at 11 Canadian universities examined for inbreeding.

Code	Unit	University
MG1	Mining and Materials Engineering	McGill University
MG2	Chemical Engineering	McGill University
MG3	Electrical & Computer Engineering	McGill University
MG4	Mechanical Engineering	McGill University
MG5	Civil Engineering & Applied Mechanics	McGill University
MM1	Engineering Physics	McMaster University
MM2	Electrical & Computer Engineering	McMaster University
MM3	Civil Engineering	McMaster University
MM4	Mechanical Engineering	McMaster University
MM5	Materials Science And Engineering	McMaster University
MM6	Chemical Engineering	McMaster University
MM7	Computing & Software	McMaster University
PM1	Mathematics & Industrial Engineering	Polytechnique Montreal
PM2	Civil, Geological & Mining Engineering	Polytechnique Montreal
PM3	Chemical Engineering	Polytechnique Montreal
PM4	Mechanical Engineering	Polytechnique Montreal
PM5	Electrical Engineering	Polytechnique Montreal
PM6	Engineering Physics	Polytechnique Montreal
PM7	Computer Engineering	Polytechnique Montreal
QU1	Mechanical & Material Engineering	Queen's University
QU2	Chemical Engineering	Queen's University
QU3	Mining	Queen's University
QU4	Electrical & Computer Engineering	Queen's University
QU5	Civil Engineering	Queen's University
UA1	Civil, Environmental, Mining & Petroleum Engineering	University of Alberta
UA2	Chemical & Material Engineering	University of Alberta
UA3	Mechanical Engineering	University of Alberta
UA4	Electrical & Computer Engineering	University of Alberta
UBC1	Mining Engineering	University of British Columbia
UBC2	Civil Engineering	University of British Columbia
UBC3	Chemical & Biological Engineering	University of British Columbia
UBC4	Material Engineering	University of British Columbia
UBC5	Electrical Engineering	University of British Columbia
UBC6	Mechanical Engineering	University of British Columbia
UC1	Geomatics Engineering	University of Calgary
UC2	Civil Engineering	University of Calgary
UC3	Chemical & Petroleum Engineering	University of Calgary
UC4	Electrical & Computer Engineering	University of Calgary
UC5	Mechanical & Manufacturing Engineering	University of Calgary
UO1	Electrical Engineering & Computer Science	University of Ottawa
UO2	Civil Engineering	University of Ottawa
UO3	Mechanical Engineering	University of Ottawa
UO4	Chemical & Biological Engineering	University of Ottawa
UT1	Institute for Aerospace Studies	University of Toronto
UT2	Materials Science & Engineering	University of Toronto
UT3	Electrical & Computer Engineering	University of Toronto
UT4	Institute of Biomaterials & Biomedical Engineering	University of Toronto
UT5	Civil & Mineral Engineering	University of Toronto
UT6	Chemical Engineering & Applied Chemistry	University of Toronto
UT7	Mechanical & Industrial Engineering	University of Toronto
UW1	Systems Design Engineering	University of Waterloo
UW2	Civil & Environmental Engineering	University of Waterloo
UW3	Management Sciences	University of Waterloo
UW4	Mechanical & Mechatronics Engineering	University of Waterloo
UW5	Chemical Engineering	University of Waterloo
UW6	Electrical & Computer Engineering	University of Waterloo
UWO1	Civil & Environmental Engineering	University of Western Ontario
UWO2	Chemical & Biochemical Engineering	University of Western Ontario
UWO3	Electrical & Computer Engineering	University of Western Ontario
UWO4	Mechanical & Material Engineering	University of Western Ontario

inbreds? In contrast to most papers in literature, we did not focus on the number of publications but on their impact which we attempt to measure with “number of citations”. Hence, we are not looking at the quantity (i.e., productivity) but at quality (i.e., the impact) of scholarly output. Arguably, the significance and impact of research may not be easily measured and one may need to look at multiple bibliometric indexes. However, the use of number of citations as a major quantifier of academic excellence is quite well established [3].

To our best knowledge, there is no central location to acquire all necessary data for this study. Hence, we used multiple sources to collect data. Looking at sources like curriculum vitae is certainly a method of data acquisition [4]. We established the list of all professors based on information provided by their respective department (instructors, lecturers and emeritus colleagues were not considered). All departments we investigated did in fact had a public list of their faculty members. In many cases, the websites of departments did provide the academic background of their faculty members and listed where they had their degrees from. Personal websites of professors were accessed by a separate search in some cases to collect and verify data. Here, we often could find details of the academic background, publications and more. Many professors post their academic and professional background on websites like *LinkedIn* and *ResearchGate*. This helped to fill some gaps. The curriculum vitae of individual professors was in many cases also a detailed source of information. *Google Scholar* pages of professor was extensively used to examine the scholarly output. In some cases, where professors had no public Google Scholar page, Google Scholar listings were used to extract the citation information. We collected multiple numbers for each unit as reported in Table 2.

We only investigated the professoriate staff and did not include lecturers whereas with “professor” we captured the full set of assistant, associate and full professors.

We proceeded university by university, but in some cases we revisited some universities to verify and double-check numbers. The entire data collection process was carried out between August 2016 and June 2017. We excluded some professors if we could not reliably verify the numbers. This was on average less than 3% in each of 60 units and was normally distributed among inbreds and non-inbreds.

3.2 Diversity versus Inbreeding

The classical definition of inbreeding, i.e., the ratio n_P/n (Table 2), neglects the general mixture of the departments. For instance, assuming we are investigating two departments A and B with 50% inbreeding. The remaining members of A have all their degrees from other universities but the remaining members of B (with Ph.D. from other universities) have their B.Sc. and M.Sc. from the same department as well. Clearly A and B have different levels of diversity on the academic background of their members. Hence, we felt the need to introduce a new formula to capture the **diversity** as the opposite of inbreeding. We started

Table 2. Data collected to investigate inbreeding at engineering schools in Canada.

n	number of professors (excl. lecturers and professors emeritus)
n_B	number of professors with B.Sc. degree from the same department
n_M	number of professors with M.Sc. degree from the same department
n_P	number of professors with Ph.D. degree from the same department
y_{med}	the median number of years for all n_P professors to be away from their university after finalizing their Ph.D.
y_{mean}	the mean number of years for all n_P professors to be away from their university after finalizing their Ph.D.
$\frac{n_P}{n}$	Inbreeding ratio, the conventional measure that only focuses on Ph.D. inbreds
c_{med}	the ratio of median number of citations of inbreds and non-inbreds, $c_{\text{med}} = \frac{\text{median}(\text{citations of inbreds})}{\text{median}(\text{citations of non-inbreds})}$
c_{mean}	the ratio of mean number of citations of inbreds and non-inbreds, $c_{\text{mean}} = \frac{\text{mean}(\text{citations of inbreds})}{\text{mean}(\text{citations of non-inbreds})}$
λ	a new measure for diversity (see Section 3.2)

with the Simpson’s index that measures the diversity D as “the degree of concentration when individuals are classified into types” when we have k types or species [20]:

$$D = 1 - \frac{1}{n(n-1)} \sum_{i=1}^k n_i(n_i - 1). \quad (1)$$

If we consider an academic unit consisting of only two types, namely inbreds and non-inbreds, hence $k = 2$, and considering that inbreeding is the opposite of diversity with respect to academic background, for n^* inbreds in a department with n members (that are otherwise assumed to be of diverse academic backgrounds) we can calculate the diversity as

$$\gamma(n^*, n) = \frac{n^*(n^* - 1) + (n - n^*)(n - n^* - 1)}{n(n - 1)}. \quad (2)$$

As inbreeding has been only considered with respect to the number of former Ph.D. students, then $1/\gamma(n_P, n)$ is equivalent to the classical definition of academic inbreeding. However, for a more accurate measurement of *diversity* in the academic background of faculty members in a department, one has to also consider the contribution on B.Sc. inbreds, $\gamma(n_B, n)$, and M.Sc. inbreds, $\gamma(n_M, n)$. The total academic diversity λ of a department can be then given as

$$\lambda = \gamma(n_P, n)^{1/\min[\gamma(n_B, n), \gamma(n_M, n)]}. \quad (3)$$

Obviously, this is only one possible way to capture the total diversity in an academic unit by simultaneous consideration of the origin of all degrees of its members.

3.3 Results

After collecting all data, we also calculated the Z scores. Table 3 shows all results.

The inbreeding index at the investigated engineering schools is lowest with 4% and highest at 50% with an average $\approx 23\%$ with a standard deviation of 11%. This average appears to be rather high. For instance, in the United States, academic inbreeding is typically less than 20% and often less than 10% [17, 12, 16]. If we set thresholds for the Z score such that we can define **very diverse** (e.g., Z score ≤ -1.0) and **dominated by inbreeding** (e.g., Z score ≥ 1.0), then this would correspond to $\lambda \gtrapprox 70\%$ and $\lambda \lesssim 40\%$, respectively. Eight units belonged to the “very diverse” group whereas 10 units fell in the “dominated by inbreeding” category. Three departments show $Z \gtrapprox 2$ which may be labelled as **governed by inbreeds**.

Both y_{med} and y_{mean} show very small results that indicate most inbreeds do not have any experience at other universities. Only for five departments, y_{med} is larger than 0, and only one department exhibits $y_{\text{med}} = 4$ years. That almost 92% of the departments show $y_{\text{med}} = 0$ shows that the majority of inbreeds do not leave their alma mater after graduation. The average years y_{mean} is less drastic as 38% of the departments have $y_{\text{mean}} = 0$. However, the average number of years for being away from alma mater is $0.89 \text{ years} \pm 1.07 \text{ years}$; the average is less than a year.

The proposed λ -diversity shows a negative correlation of 0.96 with the inbreeding index. It can provide more distinction between units by taking into account a more comprehensive quantification of academic diversity. Looking at the last 4 units in Table 3, three of them (UC1, UT2 and UW1) have the same inbreeding ratio (namely, 44%) but different λ -diversity values (namely, 29%, 25% and 22%). The last unit in Table 3, namely UT1, has an inbreeding index of 50% but a λ -diversity of 22%. Hence, UW1 and UT1 actually share the last position if we sort units based on diversity.

Across 60 departments, in seven of them inbreeds had the same citation index ($c_{\text{med}} \in [0.9, 1.1]$), in 18 units the inbreeds had higher citation index ($c_{\text{med}} > 1.1$), and in 35 units the inbreeds had lower citation index ($c_{\text{med}} < 0.9$). This is generally in conformance with other reports in literature that inbreeds are not as productive as non-inbreeds although we actually are measuring the quality of the scholarly output via number of citations. As well, our results show that the productivity of the inbreeds is also depending on other factors such that they can be productive if working in the right working climate.

Additionally, we interviewed 46 faculty members, 50% inbreeds, and asked them several questions to get an impression about what the general perception is. Almost 22% declared that hiring former students is always a problem whereas almost 56% thought it can sometimes be a problem. Roughly 11% said inbreeding is not a major issue. Nobody had selected or approved the option “inbreeding is necessary”.

Table 3. The results for 60 academic units sorted after inbreeding ratio. Green: very diverse ($Z < -1$), gray: average inbreeding ($Z \approx 0$), light red: dominated by inbreeding ($Z > 1$), dark red: governed by inbreds ($Z \gtrsim 2$).

Code	Inbreeding ratio	y_{med}, y_{mean}	c_{med}, c_{mean}	Z score	λ -diversity
MM7	4%	0, 0	3.75, 5.79	-1.76	91%
MG5	6%	0, 0	0.04, 0.02	-1.59	87%
UA4	6%	0, 0	2.26, 2.14	-1.60	87%
MG4	7%	0, 0	2.96, 2.01	-1.52	82%
UBC6	9%	0, 0	0.35, 1.77	-1.30	76%
MM6	11%	1.0, 1.0	0.18, 2.10	-1.12	72%
UBC5	12%	0, 1.5	0.60, 0.68	-1.01	74%
UO4	12%	0, 1.1	1.31, 0.65	-1.06	73%
MM5	13%	0, 0	1.79, 3.37	-0.91	65%
UBC4	13%	0, 0	0.69, 0.24	-0.99	74%
UWO3	13%	0, 0.25	0.47, 0.42	-0.91	73%
UWO4	13%	0, 0.66	0.48, 0.24	-0.99	72%
UO2	14%	4, 4.66	0.27, 0.12	-0.83	70%
UO3	14%	0, 0	0.11, 0.12	-0.89	69%
MM4	15%	0, 0	0.55, 1.06	-0.73	65%
UC5	15%	0, 0	1.30, 1.79	-0.79	67%
UO1	15%	0, 0.44	0.87, 1.15	-0.81	70%
MM2	16%	0, 1.75	0.67, 1.47	-0.66	69%
MM3	16%	0, 0	0.89, 1.34	-0.69	66%
QU5	16%	1, 3.3	0.16, 0.26	-0.69	66%
UW6	17%	0, 1.3	0.51, 0.02	-0.61	65%
MG3	18%	0, 2.57	0.73, 0.66	-0.54	58%
MM1	18%	0, 2.66	0.36, 1.32	-0.48	53%
QU4	18%	2, 2.25	1.29, 0.05	-0.48	61%
PM7	19%	0, 0	0.67, 0.32	-0.36	56%
UWO2	19%	0, 0	0.22, 0.44	-0.38	66%
UA3	20%	0, 1.44	2.92, 0.71	-0.35	62%
MG2	21%	0, 0	0.89, 0.55	-0.22	62%
UA2	21%	0, 0.18	1.03, 1.19	-0.24	56%
UA1	22%	0, 0.53	0.34, 0.32	-0.09	57%
PM6	23%	1.5, 1.5	0.71, 0.53	-0.06	43%
UBC3	23%	0, 0.28	1.95, 1.24	-0.01	58%
UW4	23%	0, 0	0.72, 0.57	-0.02	51%
UW5	23%	0, 0.3	1.45, 0.82	-0.05	58%
PM5	24%	0, 1.55	0.43, 0.16	0.02	46%
UC4	24%	0, 0	0.97, 1.22	0.07	46%
QU3	25%	0, 0	0.92, 0.74	0.14	41%
UC3	26%	0, 0	1.69, 1.19	0.21	52%
UW3	27%	0, 0.7	1.28, 0.75	0.31	54%
UT7	28%	0, 1.6	1.00, 0.81	0.44	49%
UT6	29%	0, 3.4	0.72, 1.09	0.54	39%
UW2	30%	0, 1.2	1.55, 1.52	0.55	46%
UWO1	30%	0, 1	0.88, 0.69	0.63	53%
MG1	31%	0, 0	0.78, 0.40	0.71	45%
PM3	31%	0, 3.1	0.94, 0.51	0.72	35%
PM4	31%	0, 1.07	0.74, 1.37	0.71	33%
PM2	33%	0, 0.8	2.07, 1.53	0.84	38%
UT5	33%	0, 1.4	0.79, 0.86	0.82	39%
UBC2	34%	0, 0	1.02, 0.44	1.00	43%
QU2	35%	0, 1.42	0.66, 0.80	1.05	27%
PM1	36%	0, 0.81	1.36, 0.95	1.17	34%
UC2	36%	0, 0	0.54, 0.41	1.11	45%
UT3	37%	0, 2.8	0.68, 1.35	1.20	32%
UT4	37%	0, 1.2	0.79, 0.45	1.19	28%
UBC1	40%	0, 0	3.54, 2.82	1.50	31%
QU1	43%	0, 0.41	1.33, 0.53	1.76	24%
UC1	44%	0, 1.28	1.67, 0.95	1.84	29%
UT2	44%	0, 0	0.37, 0.77	1.90	25%
UW1	44%	0, 0.3	0.16, 0.66	1.90	22%
UT1	50%	0, 1.8	1.02, 0.70	2.40	22%

3.4 Open Questions

There are many questions still open and need investigations. The two main questions in our experience are as follows:

1. **Are hiring processes being manipulated?** No department we investigated had a official and public policy to hire former students. Keeping this in mind and looking at departments with above-average inbreeding ratios, the question is whether the selection of hiring committee members is being purposefully influenced in some way to continuously hiring former students. None of the universities was “young” to justify inbreeding (i.e., due to shortage of applicants), and it is hard to believe that high inbreeding ratios are due to academic excellence of former students when the quality of their publications is not supporting this claim.
2. **Do inbred faculty continue to unfairly receive awards, positions and resources?** There have been no reports to explore the relationships between inbreeding and the frequency of awards (for teaching performance and also for research), allocation of internal resources like research space, and finally occupation of administrative positions like chair and dean positions.

4 Summary and Conclusions

The literature on academic inbreeding, which may be regarded as academic version of nepotism, is more than 100 years old, although we in Canada have not contributed to this area of academic research. In this paper, we showed, using large engineering schools, that academic inbreeding does in fact exist in Canada. As well, we showed that generally the quality of research of inbreds, measured by number of citations, is lower than non-inbreds although there are exceptions. We found that average inbreeding ratio is around 23% which may be regarded high. There are several units that show inbreeding in excess of 30%. We also introduced a new measure to quantify “diversity”, as opposed to inbreeding, and showed that it is negatively correlated with the classical definition of inbreeding. There are still many questions open and need to be investigated. This paper was a preliminary investigation to shed light on the inbreeding issue in Canada. Much effort is still required to understand inbreeding and its effect at the Canadian universities.

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