

Sample of Class Sizes and Instructors' Gender at UBC

Introduction

University is a space for learning and fostering new ideas and perspectives. Although the teaching materials are a crucial part that makes up what students learn, the learning environment may also impact the learning processes. Research has suggested that class sizes may have an influence on academic achievement in classes, specifically that smaller class size corresponds to an improvement in classroom performance (Nye, Hedges, & Konstantopoulos, 2000), potentially due to factors such as accessibility to teachers, engagement, comfortability, etc. To investigate the prospects of student success at UBC through their learning environment, we set out to find the average class size at UBC as well as whether classes are more often taught by a female instructor or a male instructor. Class sizes and instructor gender are important to us because they help give insight into what a typical classroom setting looks like for a UBC student, i.e. what kind of learning environment do students experience? Moreover, the gender of the instructor is also a topic of interest because it has been argued that there are not enough female faculty in academia. In fact, the Full-time University and College Academic Staff System (FT-UCASS) survey reveals that female instructors make up just 40% of the teaching staff in Canadian post-secondary institutions despite there being more females undergraduate and Master's students (Baggs, 2017; Civitella, 2018).

Methods

To collect our data, we selected a simple random sample (SRS) of class sizes and instructor gender in UBC courses and a stratified sample of class sizes and instructor gender in UBC courses in 4 major faculties, namely Arts, Science, Engineering/Applied Science, and Commerce and Business Administration. In our research, we choose undergraduate-level and in-class (did not include distant education, directed studies, co-op) courses. Additionally, we consider different sections of a course as different classes in order to analyze the average class size.

For both sampling methods, we used an overall sample size of 40 to ensure that we can assume data is normal under the central limit theorem. In our data collection, we used the UBC student service centre (ssc) for a comprehensive list of the courses and sections offered in the 2019 Winter session. Using a random letter generator followed by a random number generator, we obtained an SRS of class size and instructor gender. After we received a randomly generated letter we proceeded to the list of all subjects beginning with the generated letter, then we count up the x number of subjects on the list and randomly generated a number between 1 and x to choose the subject, from there we count up the number of applicable courses and randomly generate a number within that range, and then we click the undergraduate course based on randomly generated number and count up the number of non-STT sections (discussions, tutorials, and labs were not included) offered in term 1, then randomly generate a number within that range to finally find the class size in the generated section along with the professor's name. In order to confirm the gender of the professor, we searched for comments on Rate My Prof or the UBC website specifying

“he/his/him” or “she/her”. This sampling method was repeated 39 more times without replacement.

In our stratified sampling, we chose 4 different strata based on the 4 biggest faculties at UBC which are Arts, Science, Applied Science, and Commerce and Business Administration. We also have a total sample size of 40 for our stratified sampling. A similar procedure of random number generation ensued, except the range represents the number of subjects in each respective faculty. To minimize standard error (SE), we use proportional allocation to choose our sample size of each stratum. Since we do not know the total number of classes offered by UBC, we let the sample sizes be proportional to the distribution of UBC students enrolled in the 4 faculties found through the UBC enrolment statistics website. There are 5491, 14541, 4076, and 8496 students currently enrolled in faculties of Applied Science, Arts, Commerce and Business Administration and Science respectively, and we set 7, 18, 5, and 10 as the stratified sample sizes for each faculty. The target population is all the undergraduate, in-class courses at UBC in term 1 of the 2019 Winter session. The parameters of interest are the mean class sizes (X_p) at UBC in term 1, the proportion of large class sizes (large is quantified as >40 students, indicated with a ‘1’ in our data and small is ≤ 40 students, indicated with a ‘0’), and proportion of female instructors teaching UBC courses. We use a binary variable to indicate whether a class is taught by a male (1) or a female (0) instructor.

Data Summary and Analysis

SRS	MEAN	MAX	MIN	SE	CONFIDENCE INTERVAL
SIZE	50.65	245	3	8.68	(33.63, 67.67)
P_{Large}	0.35	1	0	0.075	(0.20, 0.50)
P_{Female}	0.475	1	0	0.079	(0.32, 0.63)

STRATIFIED SAMPLING (CLASS SIZE)	MEAN	MAX	MIN	SE	CONFIDENCE INTERVAL
APPLIED SCIENCE	126.14	337	21	40.39	(46.99, 205.30)
ARTS	58.72	370	7	21	(17.33, 100.12)
COMMERCE & BUSINESS	46.4	110	15	16.63	(13.81, 78.99)
SCIENCE	111.4	305	21	25.41	(61.58, 161.22)
POPULATION ESTIMATED	82.26	370	7	13.53	(55.74, 108.79)

STRATIFIED SAMPLING (P_{Large})	P_{Large}	SE	CONFIDENCE INTERVAL
APPLIED SCIENCE	0.71	0.17	(0.38, 1.05)
ARTS	0.33	0.11	(0.12, 0.55)
COMMERCE & BUSINESS	0.40	0.22	(-0.03, 0.83)
SCIENCE	0.90	0.09	(0.71, 1.09)
POPULATION ESTIMATED	0.55	0.07	(0.42, 0.69)

STRATIFIED SAMPLING (P_{Female})	P_{Female}	SE	CONFIDENCE INTERVAL
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APPLIED SCIENCE	0.14	0.14	(-0.12, 0.40)
ARTS	0.44	0.12	(0.21, 0.67)
COMMERCE & BUSINESS	0.4	0.22	(-0.03, 0.83)
SCIENCE	0.1	0.09	(-0.09, 0.29)
POPULATION ESTIMATED	0.3	0.07	(0.17, 0.43)

We assume that the class size at UBC is normally, independently and identically distributed. Our SRS results suggest that the estimated mean of the class sizes at UBC is 50.65 or around 51 students with a standard error of 8.68, and we are 95% confident that the true population mean lies between around 34 and 68 students. Our stratified sampling suggests that the estimated mean of class sizes at UBC is 82.26 or around 82 students with a standard error of 13.53 and we can be 95% confident that the average class size lies between around 56 and 109 students. Furthermore, having an average class size of over 100, the faculties of Applied Science and Science have an especially high student to instructor ratio. Arts being the biggest faculty also had the biggest range in class sizes in our sample, from a low of 7 students in a Danish class to a high of 370 students in a Psychology class. Applied Science and Science also has a large variance in the average class sizes.

Through SRS, we estimate that the proportion of class size larger than 40 is 0.35 with a standard error of 0.075 and a 95% confidence interval of (0.2, 0.5). Stratified sampling suggests that the proportion of large classes offered at UBC is 0.55 with a standard error of 0.07 and we are 95% confident that the true proportion lies between 0.42 and 0.69.

The proportion of female instructors at UBC is estimated to be 0.48 with a standard error of 0.079 using SRS while the estimated proportion is 0.30 with a standard error of 0.07 through stratified sampling, indicating that there are more male instructors than female instructors in UBC. Also not surprisingly, our result suggests that the proportion of female instructors is exceedingly small in faculties of Applied Science and Science. In contrast, the Faculty of Arts has nearly the same amount of classes taught by male and female instructors.

Conclusions

From our data, we estimated that the proportion of female faculty at UBC is less than half (estimated proportion of females is only 0.30 in our stratified sample), therefore, it is likely that there are more male instructors than female instructors in UBC; this aligns with the results found on Canadian universities in general. Thus, UBC is no exception to the gender bias for male faculty in higher-level academia. Interestingly, our estimate of the average class size using continuous vs. binary variables revealed conflicting results. When it is continuous, our data from both sampling methods seem to indicate that the average class size at UBC is relatively large (>40); however, when it is binary, the results from the two methods diverge. The SRS of class size as a binary variable seems to propose that the majority of UBC classes are relatively small yet the stratified sample seems to propose the opposite. As a result of the small sample size relative to the large population and the large variance in class sizes, the data collected from an SRS on average class size differed considerably from the stratified sample, though the 95% confidence interval did still overlap. Despite stratified sampling typically faring better (demonstrated by in-class simulation) than SRS in reducing standard error (SE), our data for class sizes was an exception, seeing that

stratified sampling produced a higher SE of 13.53 while SRS produces lower SE of 8.69. The drastic variations in class sizes between the four strata entail that aside from the different course materials in different faculties, students are also likely subject to varying learning environments, such as feeling intimidated in a class of 300 students vs. feeling comfortable in a class of 10. Based on our results, it appears that students in Science and Applied Science may be exposed to bigger classes and have more male instructors compared to students in Arts and Commerce. It can be hypothesized that the bigger classes may yield a more competitive environment but nothing can be concluded from our results.

Discussions

Our findings can help spark the question of what kind of classroom setting (including instructor-student ratio, instructor gender, number of students, classroom/lecture layout, etc.) is optimal for fostering students' learning. Future research can also look at whether the notable differences in class sizes and instructor gender between the sciences and the arts may reflect in a difference in student achievement at university. During our sampling process, we did not include any STT courses as they were restricted and we were unable to access them through our [ssc] accounts. This may implicate that a substantial number of UBC courses were excluded from our sample and hinder the generalizability of our conclusions. Another limitation is sampling size concerns. In the SRS, faculties such as Commerce and Business Administration and Economics were heavily undersampled based on random chance, and as a result, they have only one class to represent the whole faculty. Thus, the data on these faculties is unlikely to be very representative of the population mean. In addition, the individual stratum in our stratified samples does not fulfill the $n \geq 30$ criteria for the central limit theorem, thus, it would help to conduct further research with larger sample sizes to solidify our findings.

Appendix

[GENDER:Female='0'Male='1' SIZE:Small (≤ 40)=0, Large (>40)=1]

SRS:

COURSE	SIZE	SIZE_CAT	GENDER	FACULTY	COURSE	SIZE	SIZE_CAT	GENDER	FACULTY
CONS 200 001	167	1	0	Forestry	ELEC 421 101	30	0	0	Applied Science
WRDS 150	27	0	0	Arts	TIBT 100 001	12	0	1	Arts
FNH 302 001	35	0	1	LFS	IGEN 450 101	38	0	1	Applied Science
URST 200 101	104	1	1	Arts	EDST 401 007	36	0	1	Education
COGS 200 004	165	1	1	Science	SOCI 303 101	44	1	0	Arts
LAST 100 101	21	0	1	Arts	LIBE 463 63A	29	0	0	Education
NEST 301 001	46	1	0	Arts	HINU 102 001	11	0	1	Arts
RELG 330 001	16	0	1	Arts	LING 431 001	16	0	0	Arts
EPSE 308 003	195	1	0	Education	EPSE 406 63C	33	0	0	Education
BUSI 465 101	3	0	1	CBA	BMEG 201 101	15	0	1	School of BioMed Eng
NEST 304 001	49	1	0	Arts	ECON 471 001	89	1	1	Econ
GREK 201 001	15	0	0	Arts	LAW 471D 001	20	0	1	Law
KORN 415A 001	23	0	0	Arts	HEBR 201 001	10	0	1	Arts
CIVIL 418 101	70	1	1	Applied Science	MDVL 210 002	22	0	1	Arts
SPAN 321 101	17	0	0	Arts	ITAL 101 104	33	0	0	Arts

DANI 200 001	7	0	1	Arts	MUSC 120 001	70	1	1	Music
WOOD 494 101	32	0	0	Forestry	VISA 320 001	20	0	1	Arts
KIN 361 001	107	1	1	Kinesiology	PHYS 101 103	245	1	0	Science
GRS 290 001	34	0	0	LFS	LATN 350 001	13	0	0	Arts
MICB 402 101	47	1	1	Science	KIN 465 001	60	1	0	Kinesiology

Summary of SRS	SAMPLE SIZE	MEAN SIZE	MEDIAN SIZE	MEAN GENDER	MEAN SIZE CATEGORICAL
Applied Science	3	46	38	0.67	0.33
Arts	19	26.63	20	0.47	0.21
CBA	1	3	3	1	0
Econ	1	89	89	1	1
Education	4	73.25	34.5	0.25	0.25
Forestry	2	99.5	99.5	0	0.5
Kinesiology	2	83.5	83.5	0.5	1
Law	1	20	20	1	0
LFS	2	34.5	34.5	0.5	0
Music	1	70	70	1	1
School of BioMed Eng	1	15	15	1	0
Science	3	152.3	165	0.667	1

Stratified Sample:

APPLIED SCIENCE

COURSE	SIZE	SIZE_CAT	GENDER
MECH 375 101	97	1	1
CHBE 344 101	176	1	1
MTRL 486 101	21	0	1
ELEC 342 101	83	1	1
IGEN 450 101	38	0	1
APSC 100 101	337	1	0
CHBE 346 101	131	1	1

COMMERCE & BUSINESS

COURSE	SIZE	SIZE_CAT	GENDER
COEC 377 001	15	0	1
BUSI 493 101	38	0	1
COMM 295 101	110	1	1
COMM 292 101	26	0	0
BUSI 354 101	43	1	0

ARTS

COURSE	SIZE	SIZE_CAT	GENDER
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GERM 305 001	43	1	1
PSYC 309A 002	174	1	0
FIPR 436A 001	12	0	0
CSIS 200 001	39	0	1
RELG 203 001	51	1	1
ARBC 201 001	21	0	0
PERS 300 001	21	0	1
PORT 392101	9	0	0
SPAN 221 101	19	0	0
DANI 200 001	7	0	1
CHIN 341 001	24	0	0
ITAL 201 101	14	0	0
JAPN 422 001	19	0	1
HEBR 201 001	10	0	1
GERM 302	27	0	1
PSYC 102 005	370	1	1
ASIA 254 001	63	1	0
SOCI 250 101	134	1	1

SCIENCE

COURSE	SIZE	SIZE_CAT	GENDER
PHYS 117 101	305	1	1
STAT 406 101	94	1	1
BIOL 342 101	91	1	1
COGS 303 001	44	1	1
EOSC 425 101	21	0	1
STAT 302 101	122	1	1
MATH 221 102	126	1	1
PHYS 301 101	161	1	1
CPSC 221 103	105	1	1
BIOL 301 101	45	1	0

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