Report on Analysis of the APS191 Quercus Data
(Prepared by Qin Liu in summer of 2022)

Course Name: APS191 – TrackOne Seminars (Winter Term 2022)

Instructor: Dr. Chirag Variawa

Questions for Data Analysis:

- Did undeclared engineering students (i.e., TrackOne students) change their mind about their discipline of choice as they progressed through the course APS191? If so, to what degree?
- What factors did undeclared engineering students consider while making their decision about an engineering discipline for their second year of engineering studies?

Data Sources:
Weekly quiz data that were collected throughout APS191 in the Winter Term of 2022. The course enrolment was 232 students. The following three questions were asked in these quizzes from Weeks 2 to 12:
Q1: After attending today's seminar (see Appendix A for the topics of weekly seminars), are you:

- Most likely to select this engineering program
- Just as likely to select this engineering program
- Less likely to select this engineering program

Q2: Why? (please use between 50-100 words in your response).
Q3: Given what you have learned in this course to date, rank the following Engineering disciplines in order of decreasing interest according to your current interest for each as a program of study in Year 2. Students were asked to rank each discipline only once.

Results:

Choice of Engineering Disciplines

Across the 12 weeks, the undeclared first-year engineering students in 2021-22 considered the following engineering disciplines as their top choice:

- Computer Engineering (M = 34%; SD = 2.1%)
- Mechanical Engineering (M = 23%, SD = 3.2%)
- Industrial Engineering (M = 17%, SD = 2.0%)
- Electrical Engineering (M = 15%, SD = 2.3%)

Figure 1 shows the weekly variations in the ranking of all engineering disciplines as the top choice.

These students also considered the same four engineering disciplines as their second choice, with a varying level of preference.

- Electrical Engineering (M = 26%, SD = 2.6%)
- Mechanical Engineering (M = 23%, SD = 3.3%)
- Computer Engineering (M = 16%; SD = 2.0%)
- Industrial Engineering (M = 12%, SD = 3.7%)

Figure 2 presents the weekly variations in the ranking of all engineering disciplines as the second choice.

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Figure 1. Percentages of students who ranked an engineering discipline as the top choice across 12 weeks

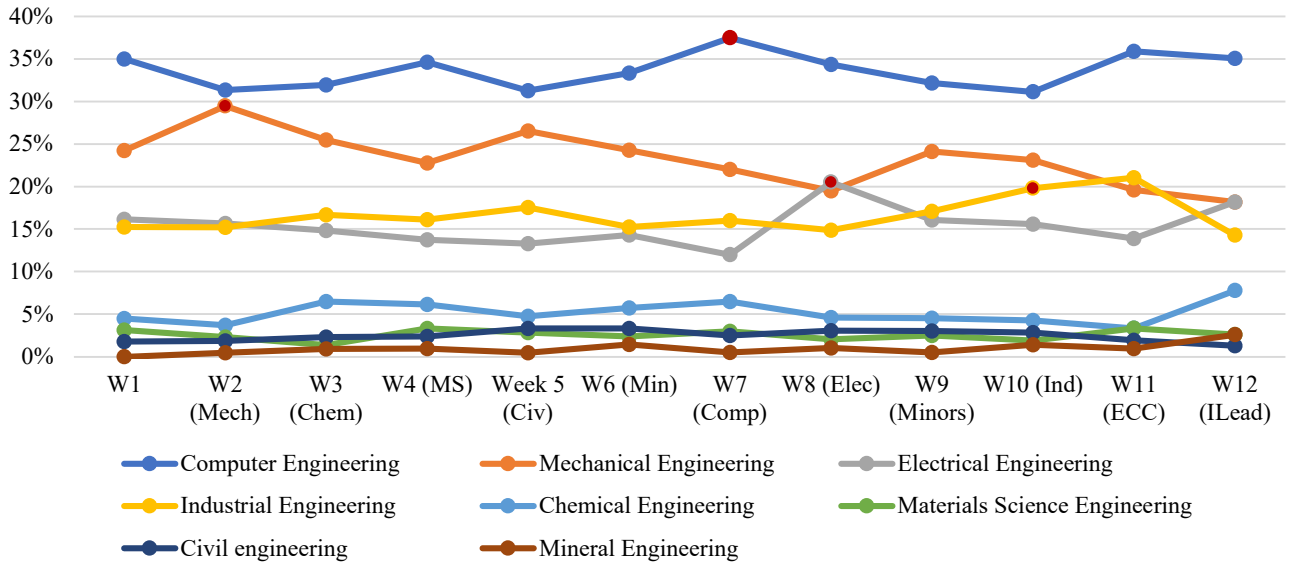
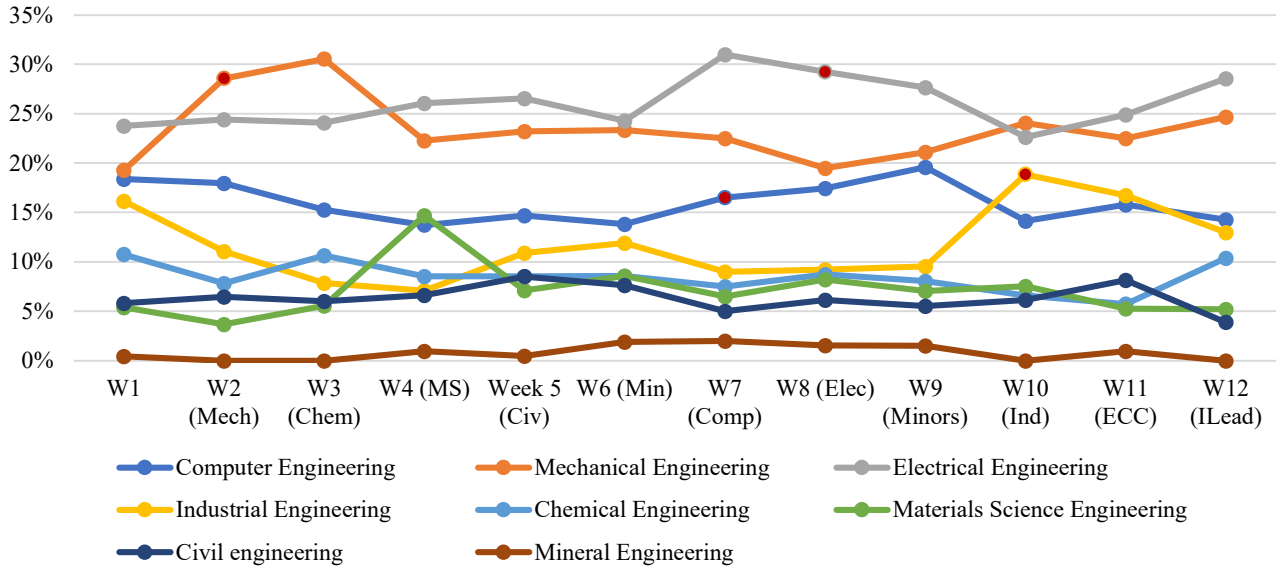


Figure 2: Percentages of students who ranked an engineering discipline as the second choice across 12 weeks



In addition, as shown in Table 1, students' choice of engineering disciplines did shift throughout the term, with variations across engineering disciplines. For example, 91% of the students who selected Industrial Engineering as their top choice in Week 1 still made the same selection in Week 11 whereas only 14% of the students who ranked Material Science Engineering as their top choice ended up with the same ranking in Week 11.

Table 1. Changes from Week 1 to Week 11 in terms of choosing the same discipline as the top choice

	W1	W11	The same students from W1 to W11	
Disciplines	**n**	**n**	**n**	**%**
Industrial Engineering	34	32	29	91%
Computer Engineering	78	72	58	81%
Mechanical Engineering	54	45	31	69%
Electrical Engineering	36	31	16	52%
Chemical Engineering	10	10	5	50%
Civil engineering	4	4	2	50%
Materials Science Engineering	7	7	1	14%

These results are arranged in a descending order of these percentages.

Impact of Class Sessions on Discipline Choice

As shown in Figure 1, during the weeks of the class sessions that featured the top four choices – Computer Engineering, Mechanical Engineering, Industrial Engineering, and Electrical Engineering (i.e., Weeks 7, 2, 10, and 8, marked in red dots in the figure), the proportions of students who chose these disciplines jumped from the previous week, which means that the class sessions appeared to have a positive impact on students' choice of these four disciplines.

Table 2 shows that class sessions featuring different programs had varying impacts on student choice of engineering disciplines, with the largest positive effect of the session on Mechanical Engineering (53% indicating "more likely") and the least positive effective of the session on Mineral Engineering (22% indicating "more likely").

Table 2. Student Perceptions of Likelihood in Choosing an Engineering Program

Weeks	Engineering Programs	n	Less likely (%)	Just as likely (%)	More likely (%)
W2	Mechanical Engineering	218	6	41	53
W10	Industrial Engineering	213	12	39	49
W4	Materials Science Engineering	212	11	45	44
W7	Computer Engineering	200	9	52	40
W8	Electrical Engineering	198	11	53	37
W5	Civil Engineering	212	10	58	31
W3	Chemical Engineering	217	10	62	29
W6	Lassonde Mineral Engineering	214	17	60	22

These results are arranged in a descending order of the "More Likely (%)".

Factors Affecting Discipline Choice

The qualitative analysis of student comments in response to Q2[1] (i.e., asking the students to explain why they were more likely or less likely to choose a certain engineering discipline after the class session featuring the discipline) revealed the following top four influencing factors for the undeclared students' decision making:

- Presentation during the class session of the week
- Expected career paths if choosing a particular discipline
- Expectations about the curriculum
- Interest in certain subject areas

Illustrating quotes from Week 2 (the class session featured mechanical engineering):

> *After watching this presentation, I had a better understanding of this program. It was my first time seeing the second-year courses of mechanical engineering, and I found the courses very interesting. Also, the presentations by the representatives gave me a glimpse of what each stream is about, and the potential projects of each stream are appealing to me as well.* (#71) [class session]
>
> *Mechanical Engineering is already one of the disciplines that I am most interested in, and this presentation only solidified my interest! I was amazed by the many different streams and career opportunities that were available to mechanical engineering students, whether it was in bioengineering, energy systems, mechatronics, etc. At the moment, I am especially interested in the mechatronics stream of the mechanical engineering program. I like that there are many different opportunities in this field, especially considering that many things in the world are becoming more automated.* (#142) [class session; career paths]
>
> *The presentation demonstrated the versatility of mechanical engineering. I really like how mechanical engineering works closely with all the other engineering disciplines, so it is a good discipline to go into if you have an interest in multiple topics, as I do. I also really love the amount of options that there are in terms of streams; I never knew there were so many. Specifically, I'm very interested in the mechatronics stream, but it's great to know that I have many other options if I change my mind.* (#140) [curriculum]
>
> *Since enrolling in track one Ive always had an eye on mechanical engineering because of the hands on and physical design aspects. The streams align with the things I enjoy doing (using CAD, Solidworks, 3d printing). Im most interested in the bioengineering and the solid design streams. I want to be able to design products that will impact people's lives and improve them. Creating and seeing my creations and designs come to life is what I'm most looking forward to and I feel like the mech program has everything I want from an engineering program.* (#173) [interest in certain subject areas]

Other influencing factors included:

- Familiarity about the discipline prior to the course
- Parental guidance
- Confidence in foundational courses
- Expected community of the engineering program
- Personal values
- Choice actions taken during the course

[1] Two undergraduate engineering students – Raili Kary and Prarthona Paul – assisted with this analysis.

The codebook used for the qualitative data analysis can be found in Appendix B.

Conclusions

The results of the APS191 data in Winter Term of 2022 led to these conclusions:

- Undeclared first-year engineering students' choice of disciplines varied. The most popular engineering disciplines for these students were Computer Engineering, Mechanical Engineering, Industrial Engineering, and Electrical Engineering.
- Students' choice of engineering disciplines shifted throughout the term as they were getting better informed about the programs in these disciplines through the course. The class sessions generally had positive effects on students' discipline choice but these effects varied considerably across weeks. The varying effects may be a result of multiple factors.
- The top four influencing factors for undeclared engineering students' discipline choice were class presentation of the week / getting better informed about the discipline, expected career paths, expectations about the curriculum, and interest in certain subject areas.
- APS191 has added value to undeclared first-year engineering students' discipline decision making, and contributed to their informed decisions about their academic pathways.

Appendices

Appendix A: Topics of Weekly Seminars in APS191, Winter Term 2022

Weeks	Topics
W2	Mechanical Engineering
W3	Chemical Engineering
W4	Materials Science Engineering
W5	Civil Engineering
W6	Lassonde Mineral Engineering
W7	Computer Engineering
W8	Electrical Engineering
W9	Minors in Engineering and Arts & Science with the Cross Disciplinary Program (CDP) Office
W10	Industrial Engineering
W11	Engineering Career Centre & PEY Co-op
W12	Troost ILead

Appendix B: Codebook for qualitative analysis of student comments

Code & Subcodes	Definition / Description	Components in the Theoretical Framework[2]
Familiarity about the discipline - Positive / Research prior to APS191 - Negative / lack of familiarity	- Had done their own program choice research before taking the course - Had investigated each of the Core8 programs when applying to undergrad - Did not know what the discipline was - Lacking information on the discipline which led to common misconceptions of the discipline	Person Inputs
Parental guidance - Positive (available) - Negative (unavailable)	- Parents are engineers - Friends/family members are engineers or are in programs - Parents/friends/family influence their education	Background
Confidence in foundational courses - Having confidence - Lack of confidence	- Perception that they previously did poorly or well in a foundational course (e.g., had poor score in Chemistry, so did not want to take Chemical engineering despite possible interest in subject area) - Felt confident or not confident in certain abilities/skills	Self-efficacy

[2] The theoretical framework is Lent et al.'s Social Cognitive Career Theory. The major reference is:
R. W. Lent, S. D. Brown and G. Hackett, Toward a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance, *Journal of Vocational Behavior*, 45(1), 1994, pp. 79–122.

Career Path - Positive (aligning with what the student desired) - Negative (misalignment)	- Specifying certain careers - Specifying working environments - Breadth in careers/lack of breadth in careers - Mentioning specific career / discipline - Lack of options in career field/locations - Uninterested in it as a career	Outcome expectations - career
Curriculum-related aspects - Breadth / diversity - Lack of breadth - Interdisciplinarity	- Availability of research opportunities - Possibilities to take minors/certificates - Lack of room for minors/certificates	Outcome expectations - curriculum
Community and class size - Positive (aligning with what the student desired) - Negative (misalignment)	- Mentioning community values - Mentioning class sizes / professor: TA-student ratios	Outcome expectations - curriculum
Interest in certain subject areas - Positive / interested - Negative / uninterested	- Past interests made them more inclined to choose a specific discipline - Uninterested in parts of the curriculum - Were more interested in courses offered in a different discipline	Interests
Discipline presentation of the week - Positive / helpful or informative - Negative / unhelpful	- The seminar presentation allowed them to understand what engineers of the field do - The seminar presentation provided information on courses taken - The seminar was not informative of the discipline - The seminar was entertaining but not helpful to better understand the discipline	Contextual influences proximal to choice behaviour
Personal values / general goals - Positive / leading towards the presented discipline - Negative / turning away from the presented discipline	- Salary consideration - Social responsibility - Aiming to get into graduate school (without specifying what kind of graduate school) - An aspect of a different discipline aligns better with personal goals	Choice goals
Defining Actions - Positive / taking an action toward the presented discipline - Negative / taking an action of turning away from the discipline	- E.g., Chose to continue to take APS105 to keep option of ECE open (mentioned in week ECE was presented) - E.g., Switched from APS105 to APS106 (mentioned in week that ECE was presented)	Choice actions