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Introduction

- COVID-19 forced classes to rapidly shift into a hybrid format, forcing adaptations that deeply altered the format students were learning in.

Impact

- Student performance acts as a primary indicator of their success. A freshman engineer's grades impacts which major they enter, if at all.

Research Questions

- How does a major change in the format of course content delivery affect student's performance?
- How does student performance on individual course topics contrast between each semester for students affected and unaffected by the pandemic?
- Which modifications led student performance to differ between pre- & post- pandemic semesters?

TABLE I
FALL 2019 COURSE TOPICS BY WEEK (DATES MAY BE CHANGED DUE TO EXIGENT CIRCUMSTANCES)

Week	Class Topics
1 (8/26-8/30)	Introduction to Course, Engineering, Programming
2 (9/2-9/6)	Sequential Steps, Variables, Assignment, Data Types
3 (9/9-9/13)	Input/Output and Modules and Calling Functions
4 (9/16-9/20)	Conditionals and Boolean Expressions
5 (9/23-9/27)	Loops and Iteration
6 (9/30-10/4)	Creating and Testing Programs; Basic Debugging
7 (10/7-10/11)	Arrays and Lists of Data (last topic on Midterm)
8 (10/14-10/18)	Top-Down Design of Programs
9 (10/21-10/25)	File Input and Output
10 (10/28-11/1)	Using Engineering Modules in Python
11 (11/4-11/8)	Writing Functions, Scope
12 (11/11-11/15)	Functions and use in top-down/bottom-up design
13 (11/18-11/22)	Systematic Debugging
14 (11/25-11/26)	Exam 2
15 (12/2-12/4)	Topic TBD
14 Finals Week	NO FINAL

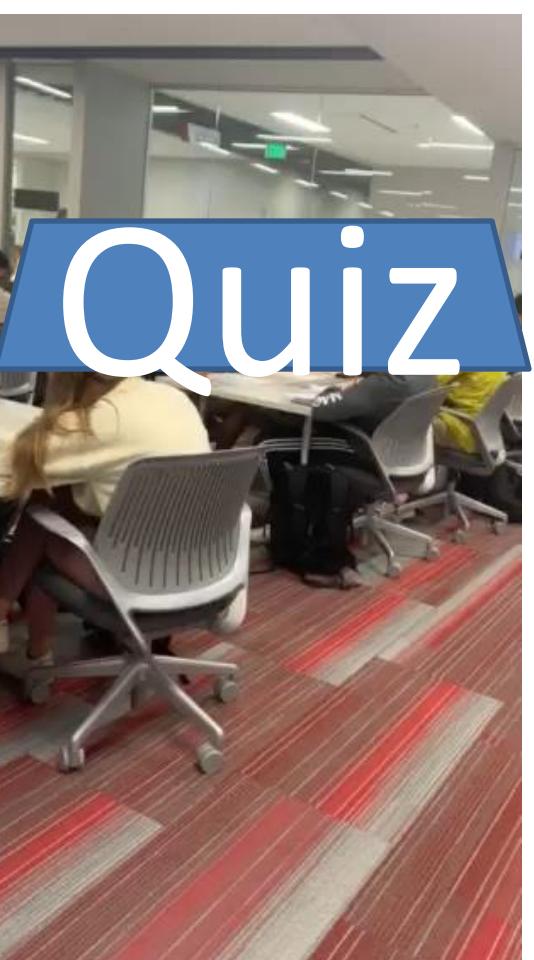
Analysis

- We first performed a quantitative analysis of grade distributions using paired t-tests & ANOVA.
- Further qualitative analysis of the specific causes of the changes came in the form of a survey.

TABLE II
PAIRED t-TEST OF QUIZZES ON QUINTESSENTIAL COURSE MATERIAL,
FALL 2019 TO FALL 2020

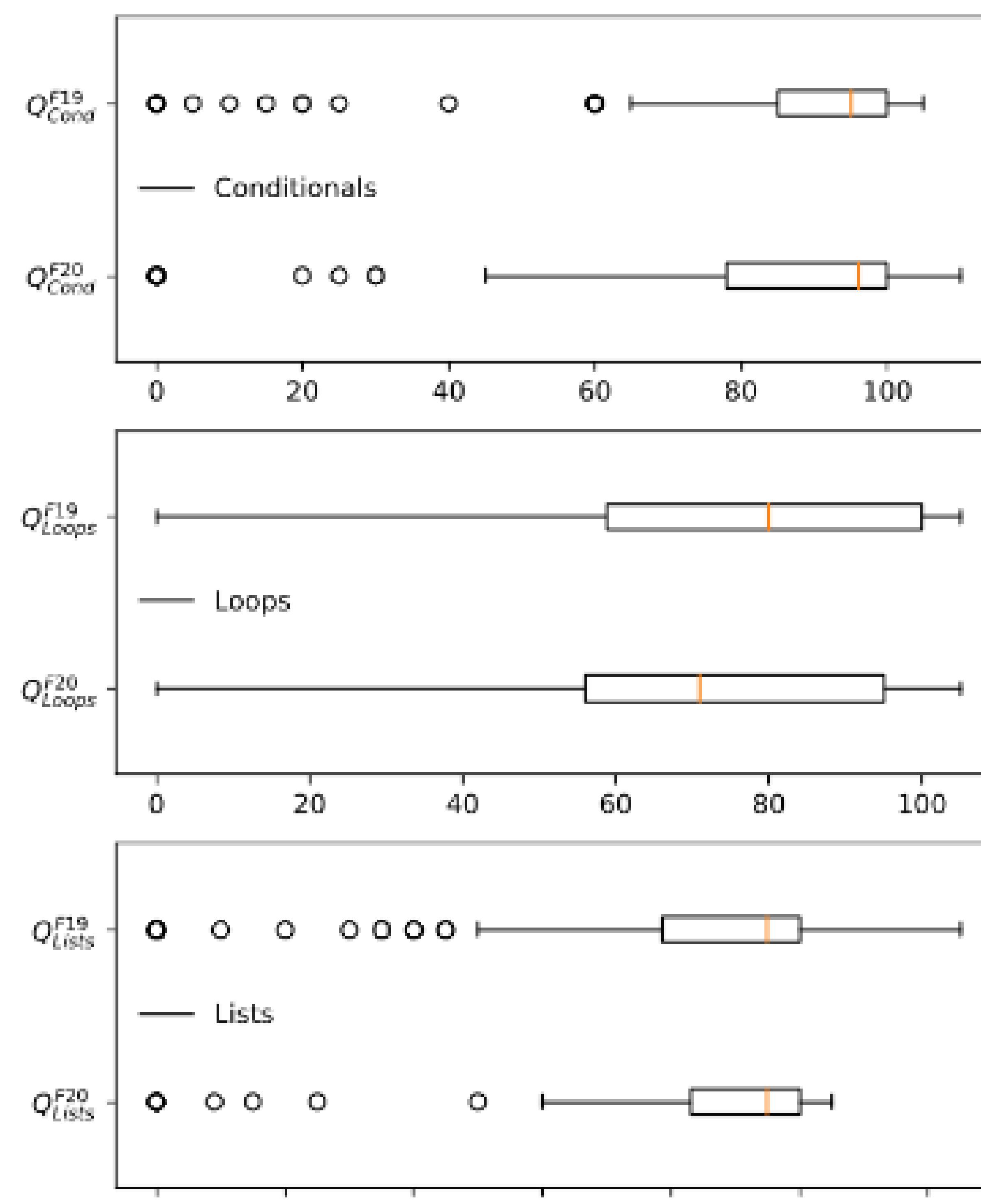
t-tests	t-statistic	p-value
Cond.: $t - test_{ind}(Q_{Cond}^{F19}, Q_{Cond}^{F20})$	5.172	3.117×10^{-7}
Loops: $t - test_{ind}(Q_{Loops}^{F19}, Q_{Loops}^{F20})$	2.0324	0.04253
Lists: $t - test_{ind}(Q_{Lists}^{F19}, Q_{Lists}^{F20})$	-0.9619	0.3365
File I/O: $t - test_{ind}(Q_{Loops}^{F19}, Q_{Loops}^{F20})$	-0.1351	0.8926
Functions: $t - test_{ind}(Q_{Lists}^{F19}, Q_{Lists}^{F20})$	2.703	0.007063

Results

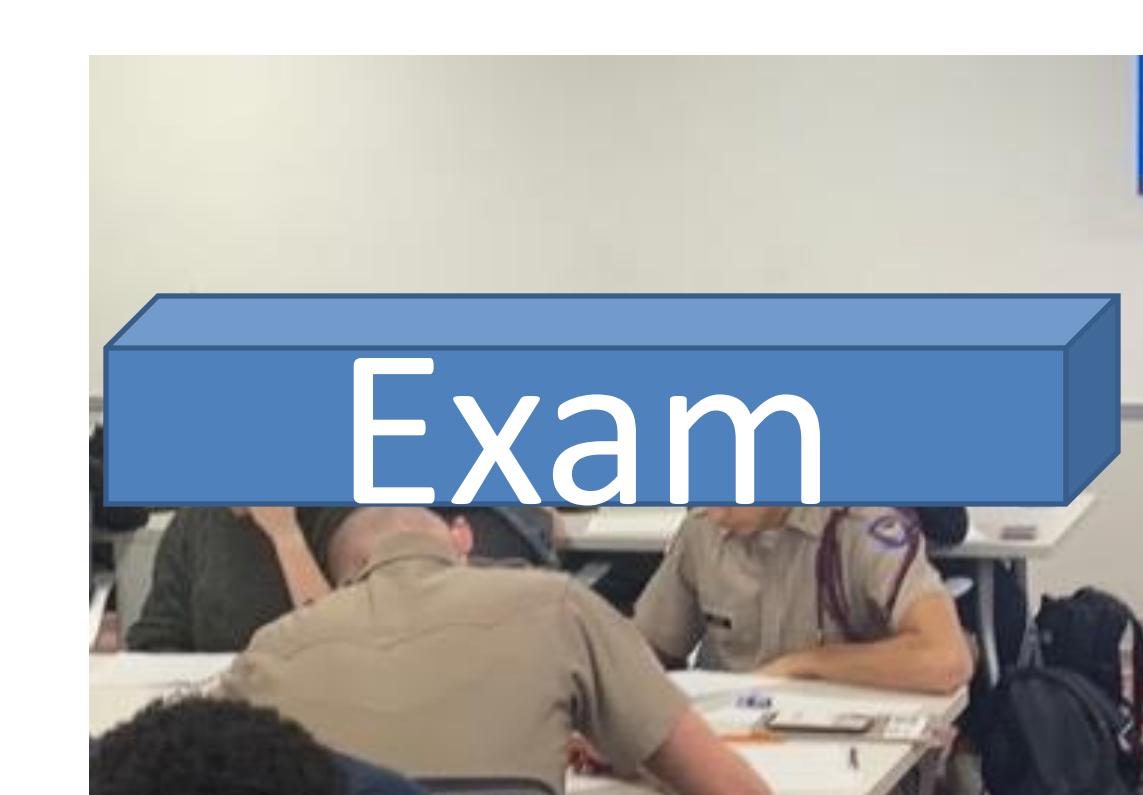
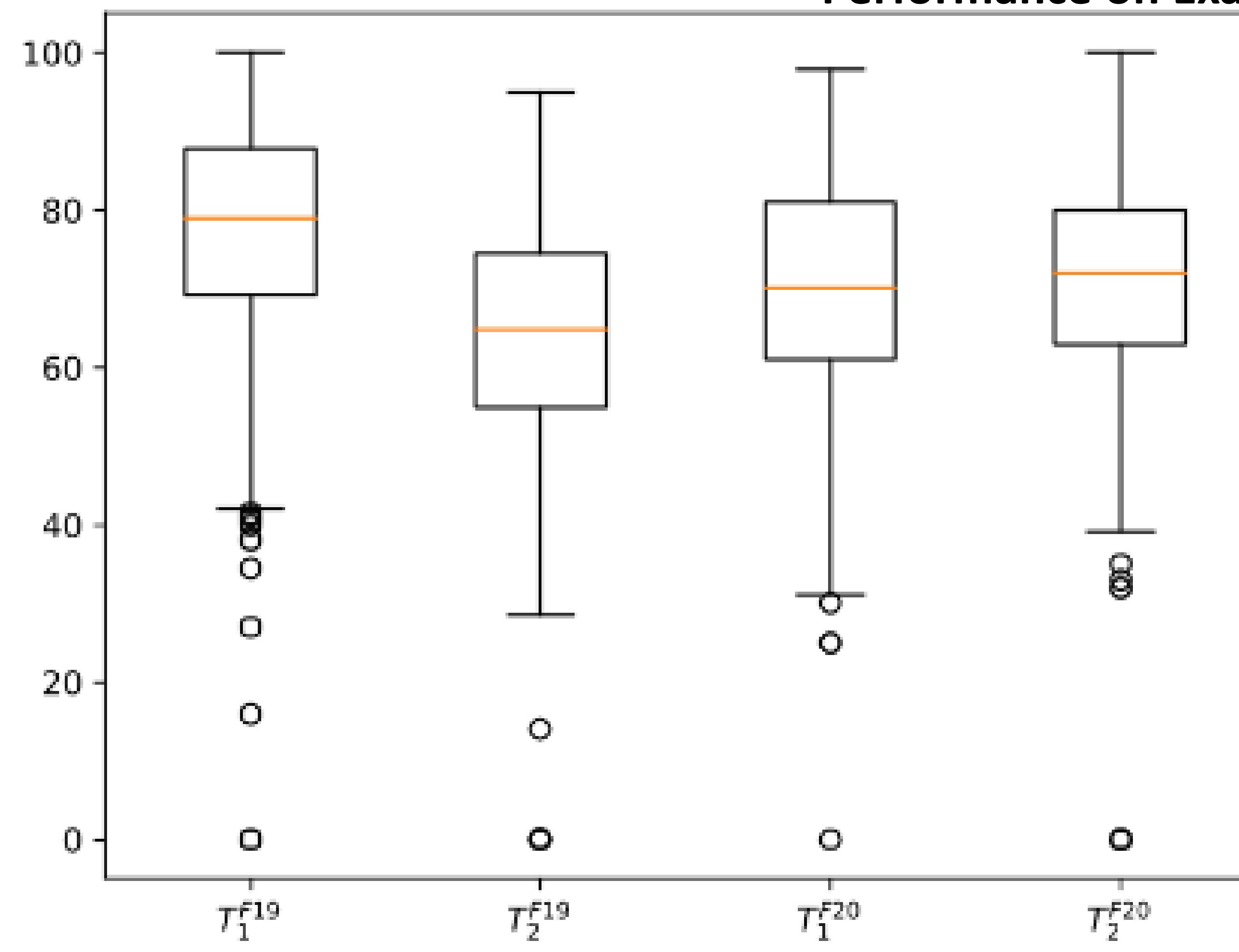


- This graph shows the grade distribution of various topics covered in ENGR 102, contrasting Fall 2019 and 2020 grades.
- The graph implies that certain topics, specifically those covered earlier in the semester, were more heavily impacted by the modifications than those later in the semester.
- Conditionals & loops showed significant changes in mean, warranting further investigation in these areas.

Performance on Quizzes



Performance on Exams



- Exam 1: t-test (F19, F20): $t_{statistic} = 5.97$, $p_{value} = 3.87 \times 10^{-9}$
- Exam 2, t-test (F19, F20): $t_{statistic} = -4.41$, $p_{value} = 3.87 \times 10^{-9}$
- Exam 1, one-way ANOVA(F19, F20): $F_{statistic} = 35.7$, $p_{value} = 3.87 \times 10^{-9}$.
- Exam 2, one-way ANOVA(F19, F20): $F_{statistic} = 19.4$, $p_{value} = 1.24 \times 10^{-5}$.

Conclusions

- Human interaction heavily affected Students prefer face-to-face despite' high experience level w/tech
- Great tech available Must refine for human connections, teaming, etc.

Future Work

Survey:

- A survey has been designed that will analyze the specific causes that impacted student performance. Some of the survey questions are exemplified below.

Example Questions:

- Did you ever join an online class's zoom and leave it on mute, or otherwise disregard it, for the duration of class?

Mark only one oval.

- Yes
 No

- Did you contract COVID-19 while taking this course?

Mark only one oval.

- Yes
 No

- Did a family member contract COVID-19 during this course?

Mark only one oval.

- Yes
 No

- How much did COVID-19 impact you or your families economic situation?

Mark only one oval.

- 1 2 3 4 5 6 7 8 9 10
Not at all impacted Extremely impacted

- How important did ENGR 102 feel, relative to your other classes that semester?

Mark only one oval.

- 1 2 3 4 5 6 7 8 9 10
Not important Just as important

Acknowledgements

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