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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

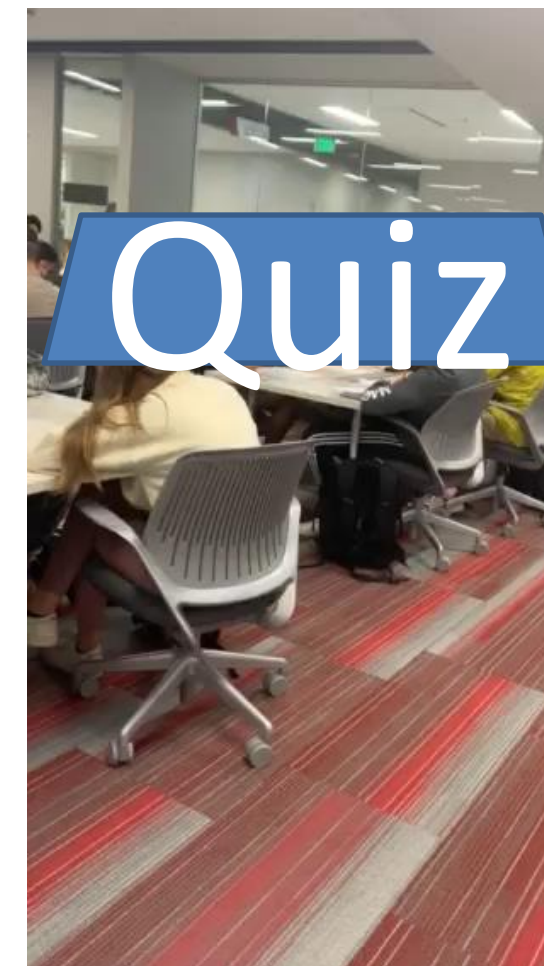
- We first performed a quantitative analysis of grade distributions using paired t-tests & ANOVA.
- Further qualitative analysis of the specific causes of the changes came in the form of a survey.

TABLE II

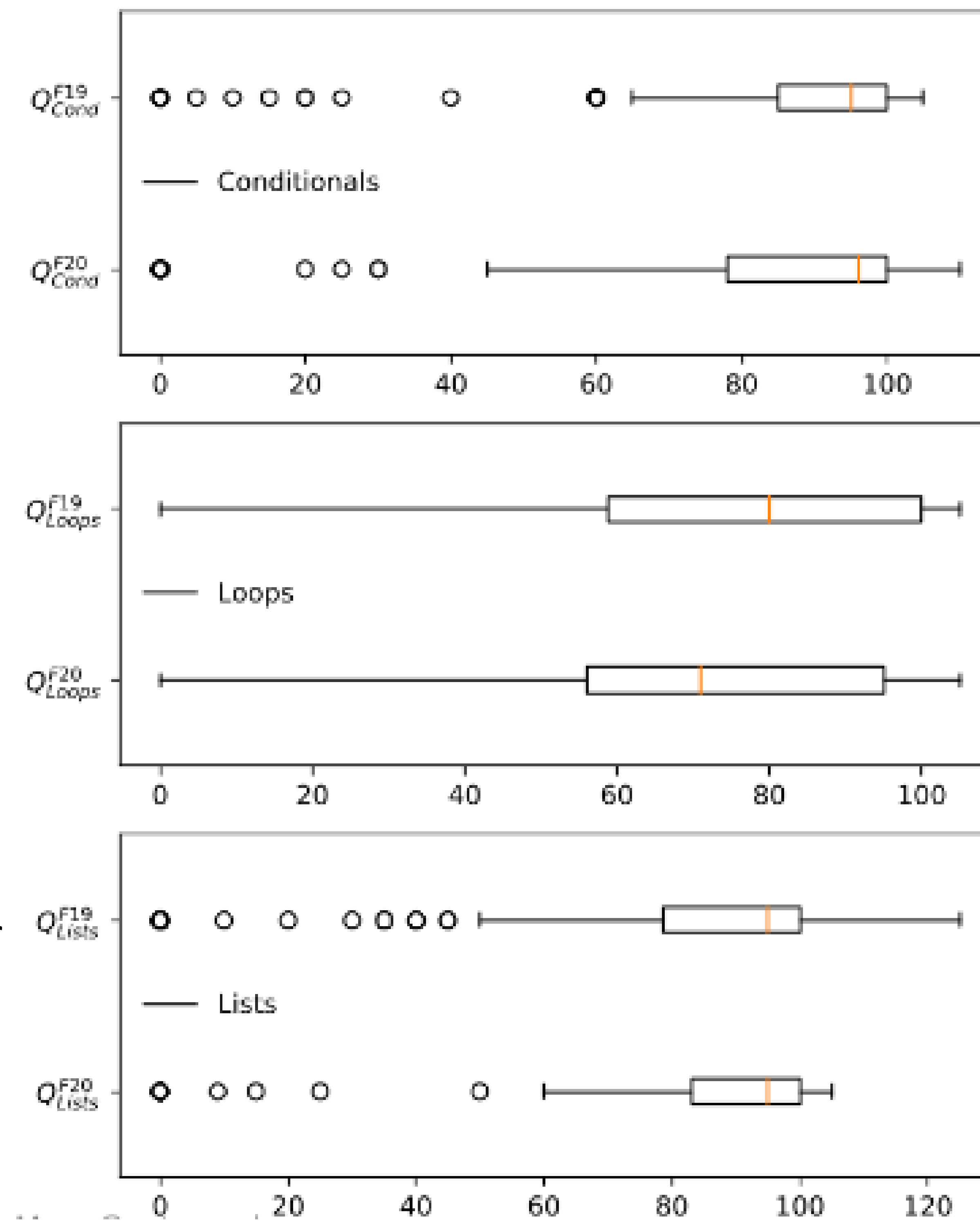
PAIRED *t*-TEST OF QUIZZES ON QUINTESSENTIAL COURSE MATERIAL, FALL 2019 TO FALL 2020

<i>t</i> -tests	<i>t</i> -statistic	<i>p</i> -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

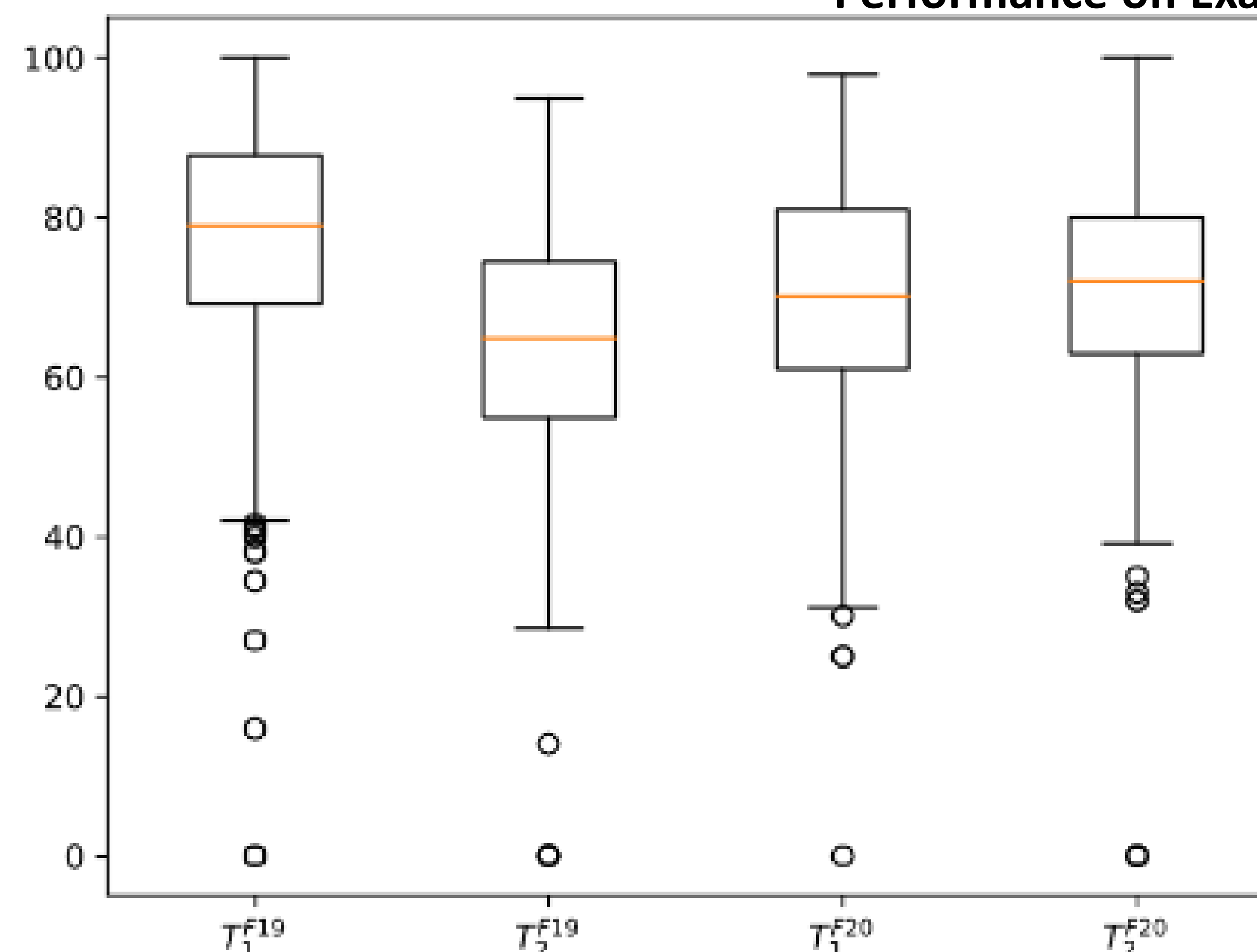


Performance on Quizzes

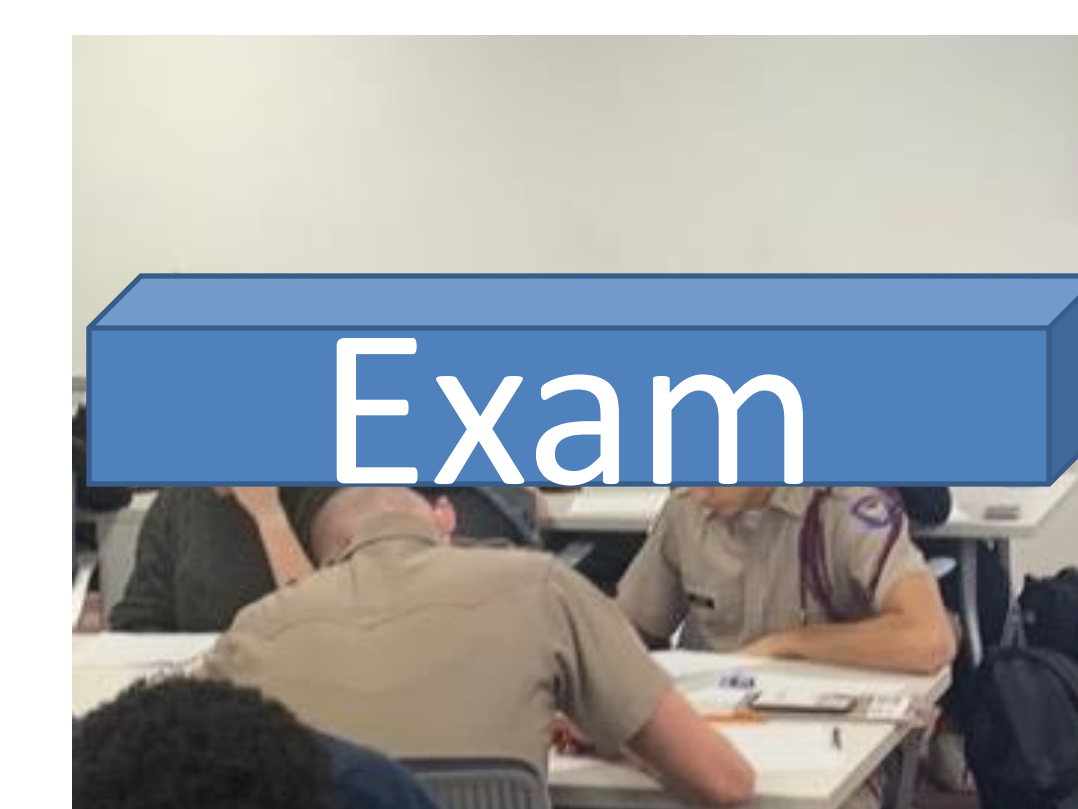


- This graph shows the grade distribution of various topics covered in ENGR 102, contrasting Fall 2019 and 2020 grades.
- The graph implies that certain topics, specifically those covered earlier in the semester, were more heavily impacted by the modifications than those later in the semester.
- Conditionals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

Performance on Exams



- Exam 1 significantly dropped in Fall 2020
- Exam 2 slightly better for Fall 2020 w/more time on topics



- 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?

13. 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

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

Mark only one oval.

- Yes
 No

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

Mark only one oval.

- Yes
 No

16. 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

17. 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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