Creative Thinking & the LSC101 Course

Group 4

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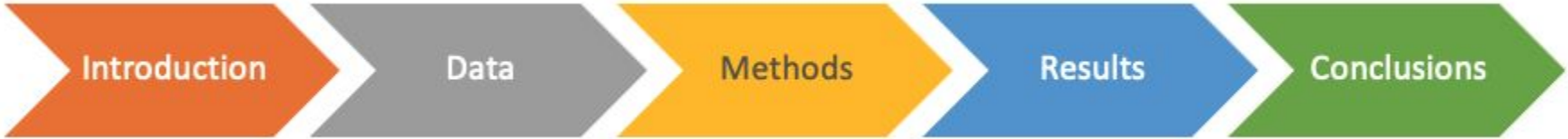
Overview



Research Ideas

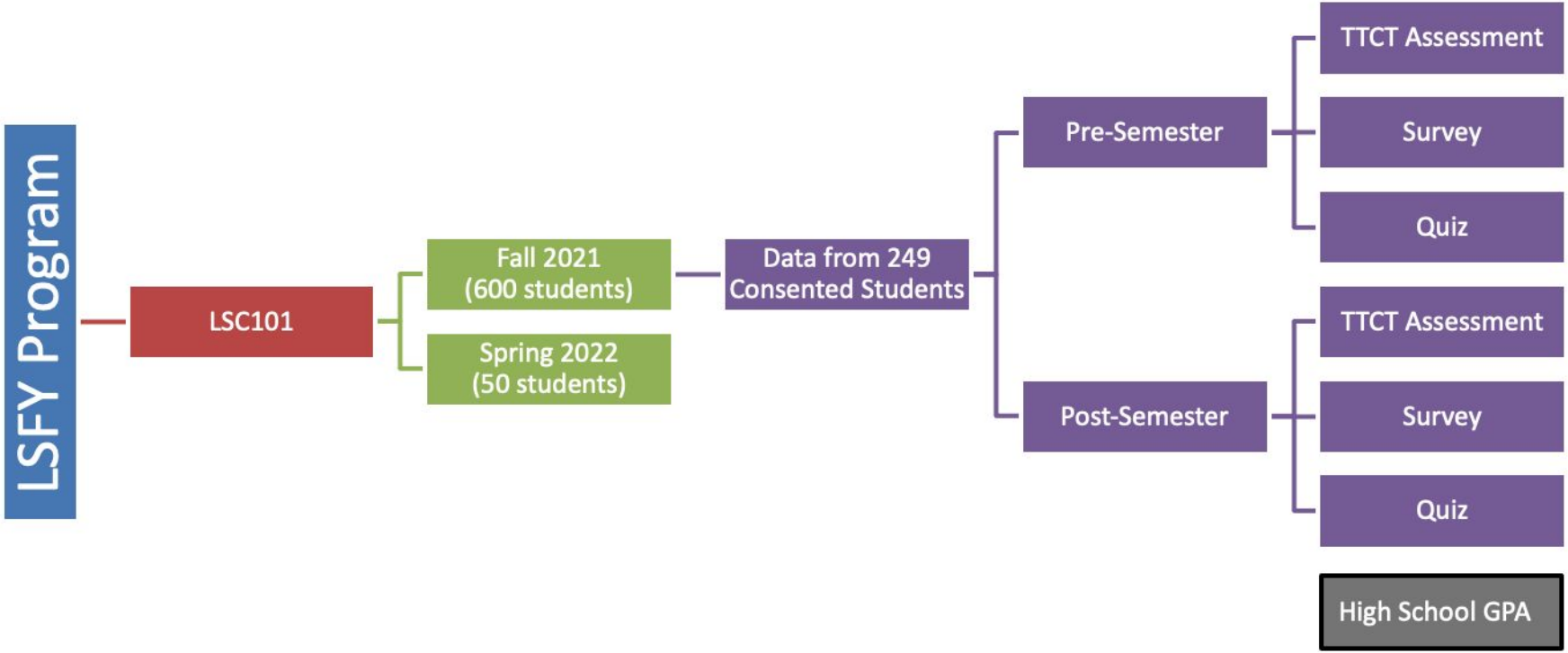
Research Idea 1

Determine if creative thinking increased as a result of taking the LSC101 course.

Research Idea 2

Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

Introduction



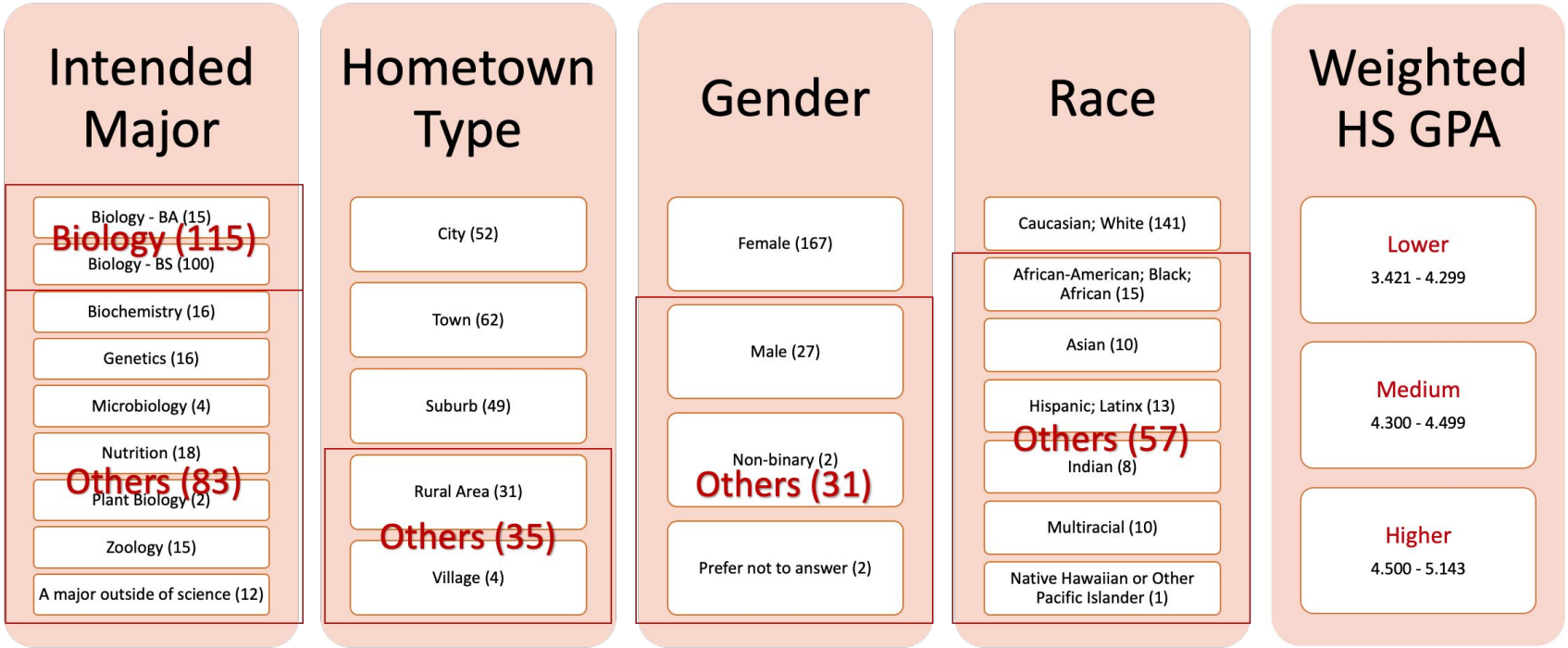
Data Collection

Torrance Tests of Creative Thinking (TTCT)

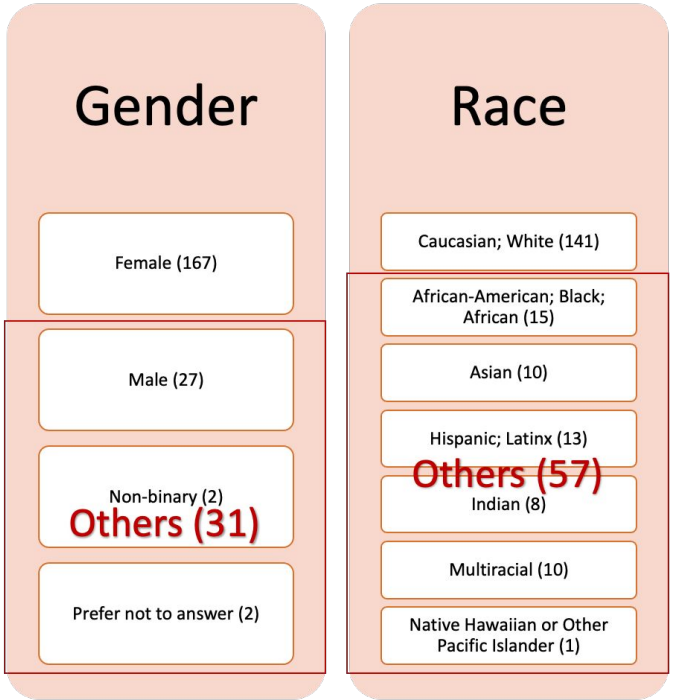
RS = Raw Score SS = Grade-based Standard Score NP = Grade-based National %-ile
LP = Local %-ile SA = Age-based Standard Score NA = Age-based National %-ile

	AGE BASED NORMS								GRADE BASED NORMS							
	Fluency		Flexibility		Originality		Average		Fluency		Flexibility		Originality		Average	
Age / Gender	SA	NA	SA	NA	SA	NA	SA	NA	SS / RS	NP / LP	SS / RS	NP / LP	SS / RS	NP / LP	SS	NP / LP
18	100	49	103	55	92	35	98	48	104	57	105	60	98	46	102	54
1									77	74	44	76	49	60		70

Data Processing



Ethical Considerations



"Ethical statistical practitioner considers the impact of statistical practice on society, groups, and individuals. Recognizes that statistical practice could adversely affect groups or the public perception of groups, including marginalized groups. Considers approaches to minimize negative impacts in applications or in framing results in reporting."

Data Processing

Cleaning of problem areas:

- Mismatching of pre- and post-semester demographic information
  - gender, race, student ID, hometown type, zip code, intended major
- Duplicated Entries
- Incomplete information

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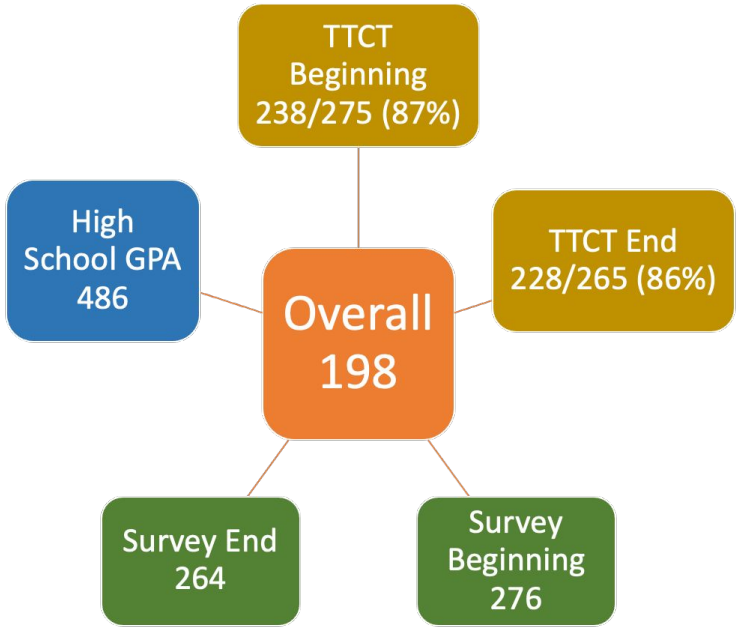


Research Idea 1

Determine if creative thinking increased as a result of taking the LSC101 course.

Method

Paired Sample t-Test

Motivation

Each student takes the TTCT assessment twice, producing 2 scores: score before and score after taking the LSC101 course.

Hypothesis

$H_0: \mu_b = \mu_e$

$H_1: \mu_b < \mu_e$

Interpretation

If the p-value calculated using the test statistic *t* with *n-1* degrees of freedom is less than our chosen significance level of 5%, then we will reject the null hypothesis that there's no difference in mean TTCT score before and after the semester.

Research Idea 1

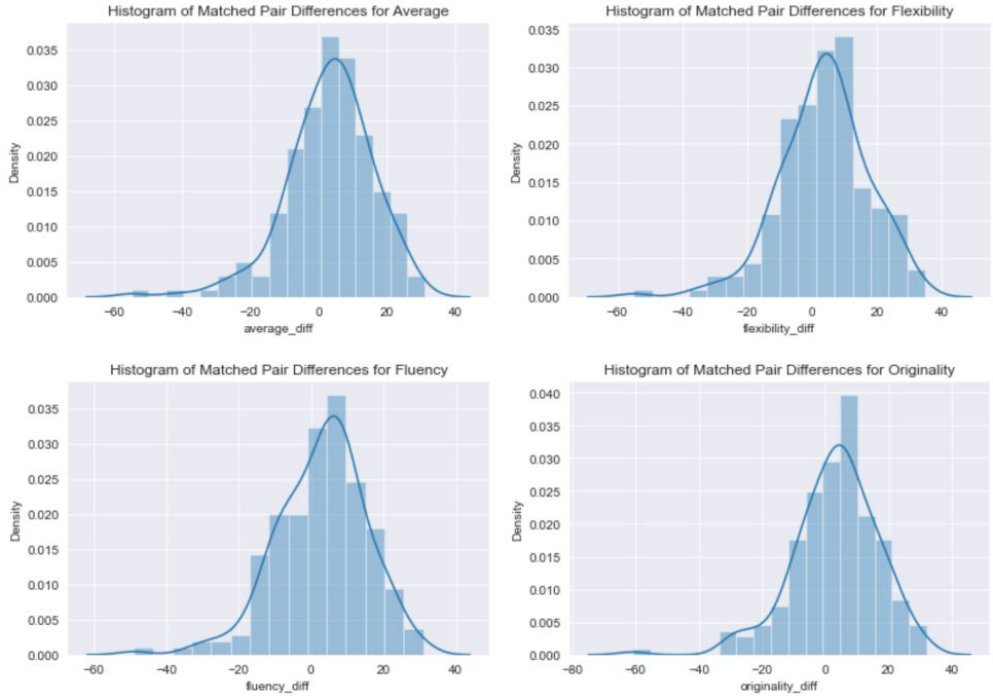
Determine if creative thinking increased as a result of taking the LSC101 course.

Method

Paired Sample t-Test

Assumptions

- Observations should be independent of each other.
- The differences between the matched pairs should be approximately normally distributed.
- The differences between the matched pairs should not contain extreme outliers.



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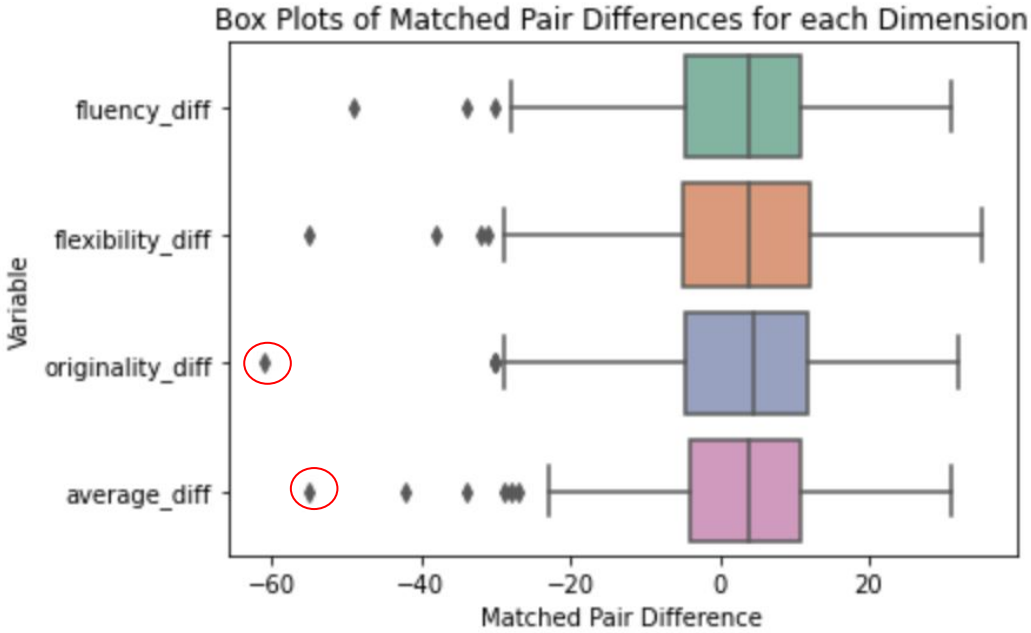
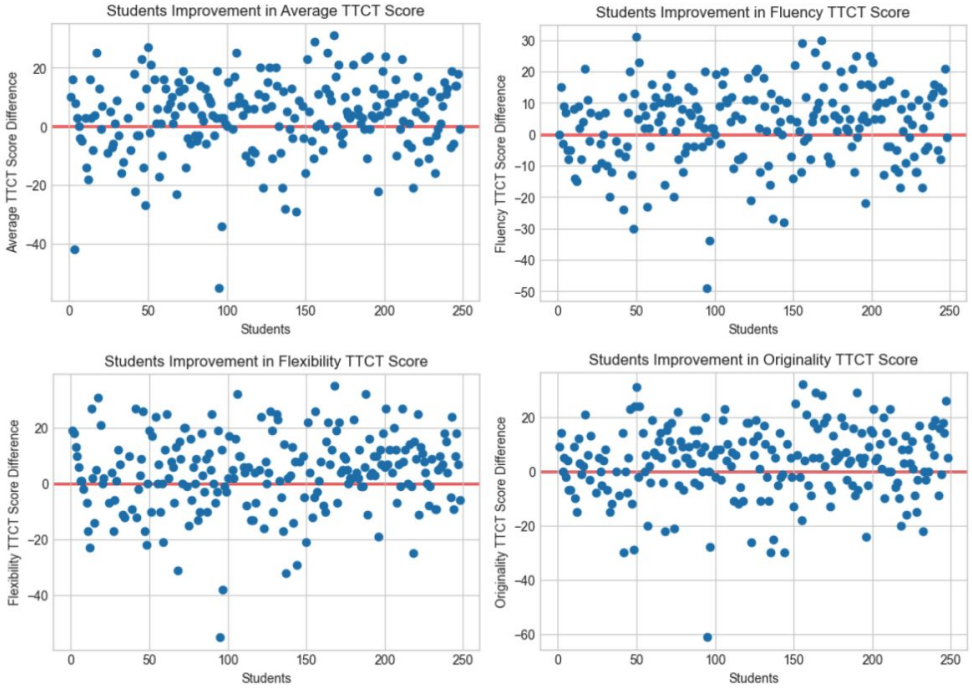


Tukey's Box Plot Method: Obs76

Research Idea 1

Determine if creative thinking increased as a result of taking the LSC101 course.

EDA



Dimension	% of Score Increase	% of Score Decrease	% of Score No Change
Fluency SA	63%	35%	2%
Flexibility SA	63%	35%	2%
Originality SA	62%	32%	6%
Average	61%	34%	5%

Approximately 2 out of 3 students increased their TTCT score after taking the LSC101 course.

Research Idea 1

Determine if creative thinking increased as a result of taking the LSC101 course.

EDA

Paired Sample t-Test

Including obs. 76 (probable outlier)

Fluency SA Means	Flexibility SA Means	Originality SA Means	Average Means
• Pre: 90.14 • Post: 93.04	• Pre: 89.68 • Post: 93.44	• Pre: 88.38 • Post: 91.62	• Pre: 89.65 • Post: 92.70

Excluding obs. 76 (probable outlier)

Fluency SA Means	Flexibility SA Means	Originality SA Means	Average Means
• Pre: 90.05 • Post: 93.21	• Pre: 89.56 • Post: 93.62	• Pre: 88.26 • Post: 91.82	• Pre: 89.54 • Post: 92.88

Research Idea 1

Determine if creative thinking increased as a result of taking the LSC101 course.

Results

Paired Sample t-Test

Including obs. 76 (probable outlier)

Dimension	P-Value
Fluency SA	0.00125
Flexibility SA	0.00015
Originality SA	0.00081
Average	0.00101

Excluding obs. 76 (probable outlier)

Dimension	P-Value
Fluency SA	0.00026
Flexibility SA	0.00000
Originality SA	0.00010
Average	0.00016

Interpretation

Reject the null hypothesis, there is statistically significant difference in pre and post semester mean TTCT scores.

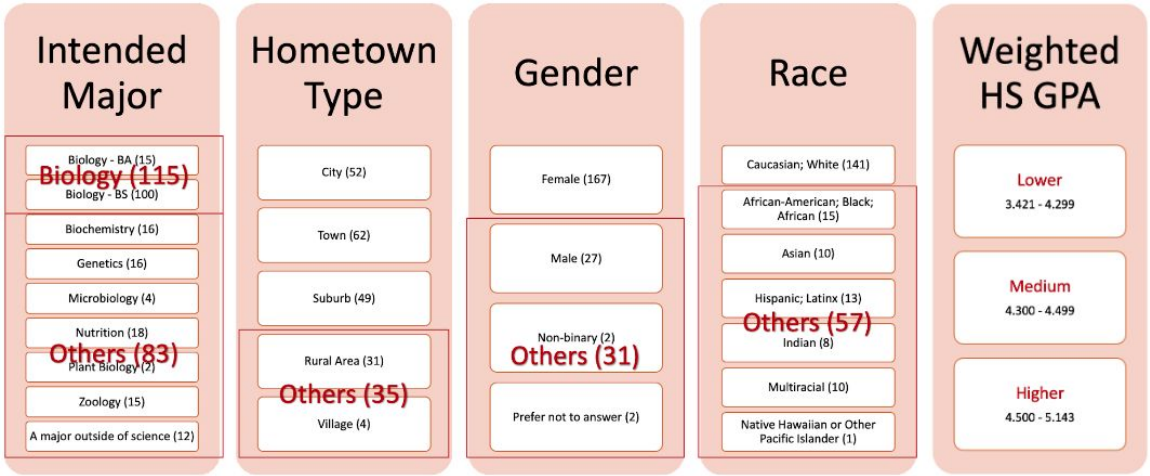
Research Idea 2

Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

Method

Approaches:

1. Analyzing each level of the predictor variable
2. Comparing levels of a predictor variable
3. Controlling for race and gender, analyze the effects of intended major, hometown type, and GPA

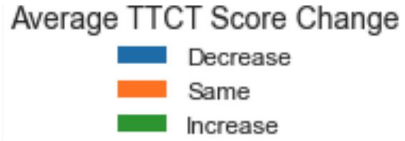


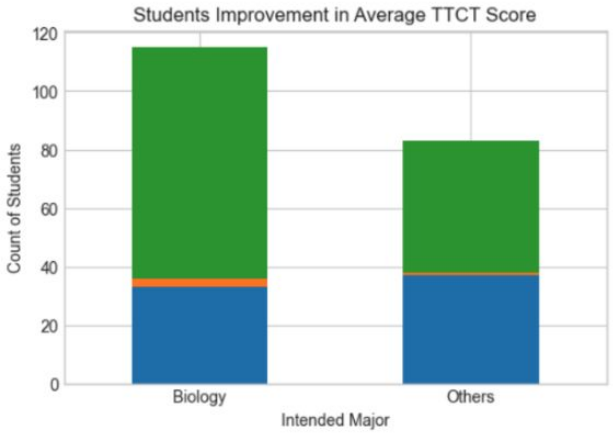
Research Idea 2

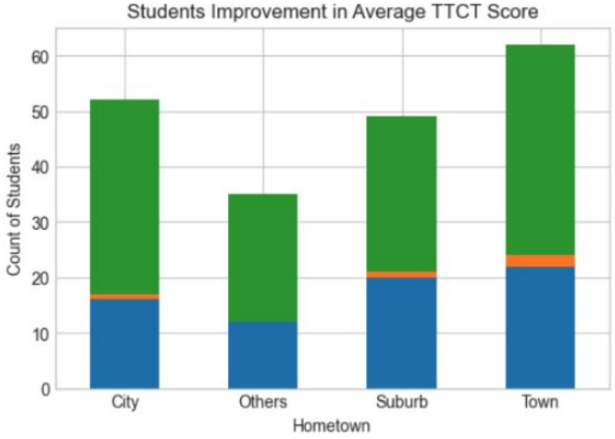
Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

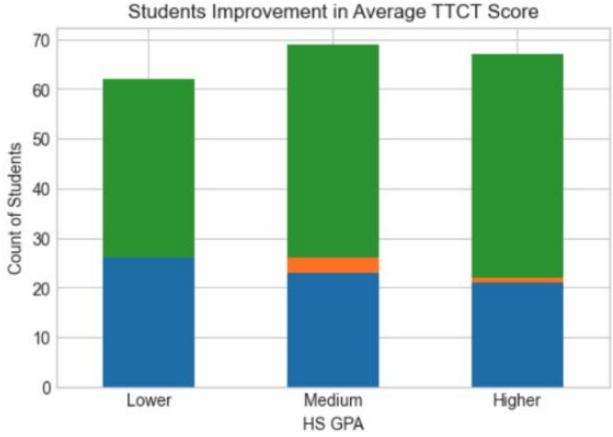
EDA

Approach 1: Analyzing each level of the predictor variable









Research Idea 2

Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

Results

Paired Sample t-Test

Approach 1: Analyzing each level of the predictor variable

Intended Major		Hometown		HS Weighted GPA	
Level	P-Value	Level	P-Value	Level	P-Value
Biology	0.0001 (< 0.05)	Town	0.0176 (< 0.05)	Lower	0.3044 (> 0.05)
Others	0.6830 (> 0.05)	City	0.1341 (> 0.05)	Medium	0.0362 (< 0.05)
		Suburb	0.2004 (> 0.05)	Higher	0.0170 (< 0.05)
		Others	0.1572 (> 0.05)		

Research Idea 2

Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

Method

2 Sample t-Test

HS Weighted GPA	
Level	P-Value
Lower	0.3044 (> 0.05)
Medium	0.0362 (< 0.05)
Higher	0.0170 (< 0.05)

Approach 2: Comparing levels of a predictor variable

Motivation

- Numeric response variable
- Binary predictor variable
- Comparing means for 2 samples

Assumptions

- Independent samples
- Normal for each group or apply CLT with large sample
- Random sample

Hypothesis

$$H_0: \mu_{medium} = \mu_{higher}$$

$$H_1: \mu_{medium} \neq \mu_{higher}$$

Research Idea 2

Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

Result

2 Sample t-Test

Approach 2: Comparing levels of a predictor variable

HS Weighted GPA	
Level	P-Value
Lower	0.3044 (> 0.05)
Medium	0.0362 (< 0.05)
Higher	0.0170 (< 0.05)

P-value: 0.71481 > 0.05

Interpretation

Do not reject the null hypothesis, mean of the Medium GPA group is not significantly different from the mean of Higher GPA group.

Research Idea 2

Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

Method

Approach 3: Controlling for race and gender, analyze the effects of intended major, hometown type, and GPA.

$$Y_{ijklms} = \mu + \alpha_i + \beta_j + \gamma_k + \lambda_l + \upsilon_m + (\gamma\lambda)_{kl} + (\gamma\upsilon)_{km} + (\lambda\upsilon)_{lm} + (\gamma\lambda\upsilon)_{klm} + E_{ijklms}$$

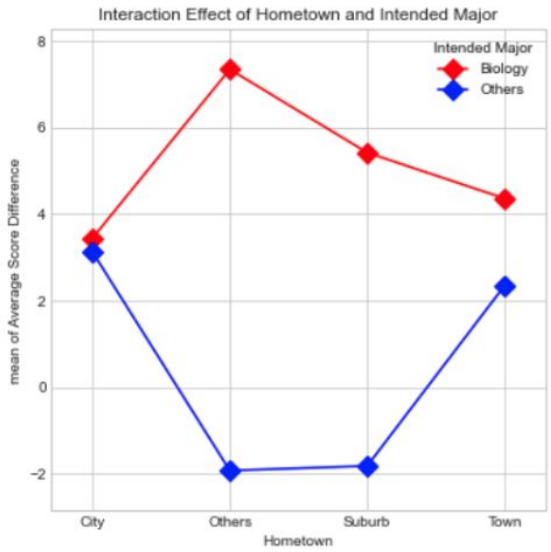
α_i - the factorial effect for the i-th level of gender
β_j - the factorial effect for the j-th level of race
γ_k - the factorial effect for the k-th level of intended major
λ_l - the factorial effect for the l-th level of hometown
υ_m - the factorial effect for the m-th level of high school GPA
the other terms are the corresponding interaction terms.

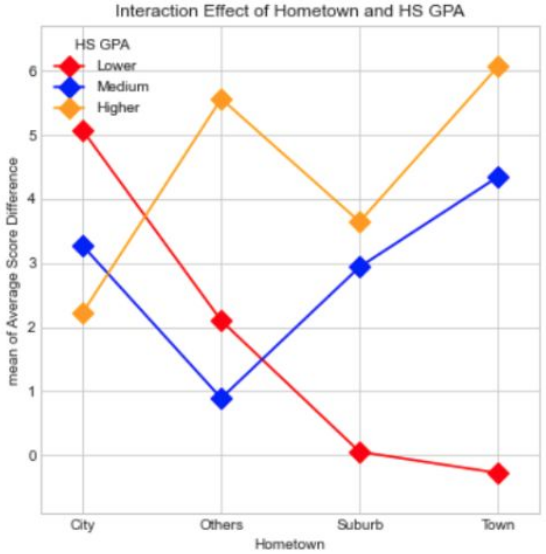
Research Idea 2

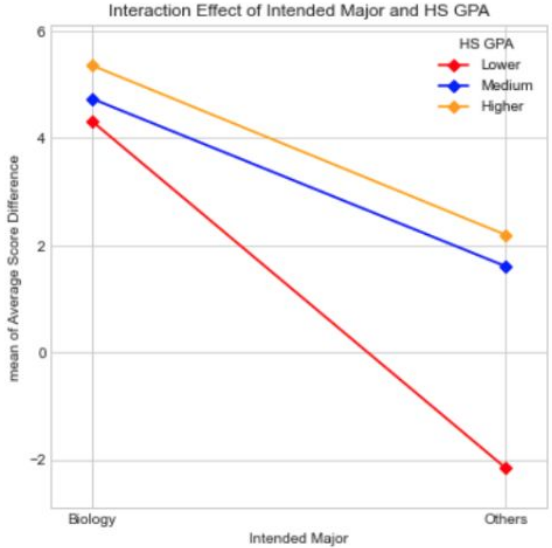
Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

EDA

Approach 3: Controlling for race and gender, analyze the effects of intended major, hometown type, and GPA.







Research Idea 2

Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

Method

Multi-way ANOVA

Approach 3: Controlling for race and gender, analyze the effects of intended major, hometown type, and GPA.

Motivation

- A quantitative dependent variable
- Multiple levels of two categorical independent variables.

Assumptions

- Independent samples
- All populations are normal
- Equal population variances

Research Idea 2

Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

Results

Multi-way ANOVA

Approach 3: Controlling for race and gender, analyze the effects of intended major, hometown type, and GPA.

- The overall model was not significant
- P-value of F-statistic: 0.365
- R-squared: 0.136
- No significant interaction effects
- Only significant main effect: Intended Major

5-Way ANOVA	
Predictors	P-Value
Intended Major	0.0215 (< 0.05)
Hometown	0.9473 (> 0.05)
HS Weighted GPA	0.5518 (> 0.05)
Race	0.9411 (> 0.05)
Gender	0.3196 (> 0.05)
Major & Hometown	0.2026 (> 0.05)
Major & HS GPA	0.6585 (> 0.05)
Hometown & HS GPA	0.4463 (> 0.05)
Major & Hometown & HS GPA	0.2570 (> 0.05)

Research Idea 2

Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

Method

Tukey-Kramer Test

Approach 3: Controlling for race and gender, analyze the effects of intended major, hometown type, and GPA.

Motivation

- After running an ANOVA and rejecting the null hypothesis
- Find out which specific groups' means (compared with each other) are different.

Assumptions

- Independent samples
- All populations are normal
- All population variances are equal

Research Idea 2

Examine whether patterns exist in creative thinking with demographics (eg. race, gender, hometown, intended major).

Result

Tukey-Kramer Test

Approach 3: Controlling for race and gender, analyze the effects of intended major, hometown type, and GPA.

Multiple Comparison of Means - Tukey HSD, FWER=0.05

group1	group2	meandiff	p-adj	lower	upper	reject
Biology	Others	-4.2685	0.0206	-7.8748	-0.6622	True

Interpretation

Reject the null hypothesis and conclude that mean differences in the average score is different between Biology students and students intending to study other majors.

Conclusions

By taking the LSC101 course, TTCT scores in all 4 dimensions showed improvements, indicating students' creative thinking abilities increased.

While controlling for race and gender, only intended major had slightly significant effect on the improvement of average TTCT scores.	No significant interaction patterns in demographics were observed.	Possibility of other "lurking" explanatory variables that explain the variability in the score difference.

Thank You!

Faleminderit!

谢谢你!