Spring 2017

Statistical Methods (STA 2023) Assessment

Assessment Day

May 5, 2017

Agenda

- Introduction
  - Objective of Assessment
  - Leadership
  - Objective of Assessment Day
- Chronology
- Thanks
- Results
- Assessment Question & Rubric Refinement Discussion
- Other topics
- Path Ahead

Introduction

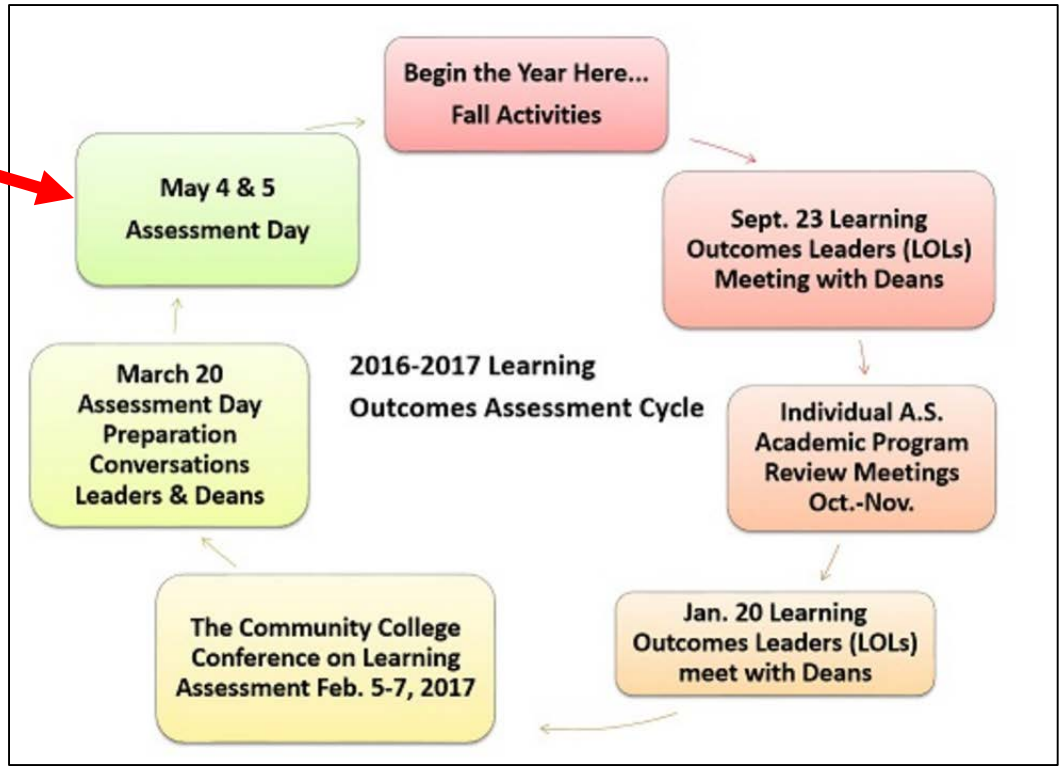
- Objective of Assessment:
  - Assess student learning outcomes at the end of the semester
  - Evaluate aggregate student artifacts for purposes of program improvement, gatherings student videos, analyzing exam results, etc.
  - Evaluation involves faculty teams across the program/ discipline

Introduction

- Leadership:
  - Past:
    - Roberta Carew on sabbatical
  - Temporary (through Assessment Day):
    - Jon Stevens
    - Mary Thompson
  - Future:
    - TBD

Introduction

- Objective of Assessment Day:
  - Present assessment results
  - Refine assessment question and/or rubric based on lessons learned
  - Discuss path ahead



Chronology

- Jan 27:
  - Preparation session/norming exercise conducted (n=8+2)
- Feb:
  - Evaluations returned to Jon & Mary
- Mar - Apr:
  - Data analysis
  - Data presentation
- May 5 (Assessment Day):
  - Presentation of results
  - Assessment question & rubric refinement
  - Commence tentative planning for the next assessment cycle

Thanks

- Magdala Emmanuel
- Allison Sloan
- Kenny Bingle
- Misty Bozzacco
- Lynn Howard
- Sandra Draper
- Brian Macon
- Jody DeVoe
- Melanie Olivier (aka - "the MVP")

Results

- 200 students randomly selected from all campuses
- 139/200 (68.5%) of artifacts useable
  - No-shows
  - Withdrawals
  - Missing
  - Instructors manipulating the question thus rendering the artifact as unusable
- 10 faculty members participated in artifact scoring after completing group norming exercise

STA2023 Common Final Exam Question (Fall 2016) **Name : _____**

The manufacturer of a new hybrid sports utility vehicle (SUV) states that it gets an average of 48 miles per gallon (mpg) on the highway. A consumer group suspects that perhaps the new SUV's gas efficiency is lower than the manufacturer's statement. Assume that the gas efficiency of the SUV is approximately normally distributed. The consumer group randomly tests 13 of the new SUV's under similar highway conditions and obtains the following results:

39, 40, 41, 42, 43, 43, 44, 45, 45, 46, 47, 47, 50

1a) Write the **Hypotheses statements** below to test the consumer group's claim:

H_0 : _____

H_a : _____

1b) Which Hypothesis represents the consumer group's claim? (Circle one: ***Null Hypothesis (H_0)*** or ***Alternative Hypothesis (H_a)***

2) Explain what type of hypothesis testing you will perform and whether conditions are met.

3a) Test this hypothesis using a significance level of $\alpha = 5\%$. (SHOW WORK!)
Include work for: Clearly labeled sketch with appropriate shading and calculation of the test statistic

Solve

3b) Would you reject or fail to reject the null hypothesis? (Circle one: ***Reject H_0*** or ***Fail to Reject H_o)***

4a) Using a significance level of $\alpha = 5\%$, write a conclusion in the context of this problem:

4b) A friend is looking for an SUV that averages 48 mpg or more on the highway. Would you advise your friend to purchase this new model SUV? (Circle one: **YES** or **NO**)

Quantitative Reasoning Results

QR Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Classifying and utilizing facts and formulas correctly **#3A: Calculates mean, std. dev. and test statistic**	Utilizes mathematical facts and formulas incorrectly or inappropriately -Or- Omits them altogether • May calculate irrelevant information or • May show significant lack of knowledge in the calculation of relevant information.	Utilizes mathematical facts and formulas with significant inaccuracies and/or omissions In calculating mean, standard deviation and test statistic, • leaves one out completely and/or • makes significant errors on most of them.	Utilizes mathematical facts and formulas with moderate inaccuracies and/or omissions For the most part, correctly calculates Mean, test statistic and standard deviation, but may have: • used σ instead of s • Mean incorrect due to omitted/incorrect value. • test statistic work partially incorrect • Correct values, but no work shown.	Utilizes mathematical facts and formulas accurately Calculates correctly & shows work (by-hand or calculator function) for: • Mean • Sample Std. Dev. • Test Statistic consistent with test choice in #2 • If using calculator, should note somewhere "1-Var Stats"

QR Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Constructing a mathematical model **#3A Draws Relevant Diagram or otherwise organizes relevant information.**	Constructs an incomplete or inappropriate model for the given data -Or- Omits model completely	Constructs a model for the given data with significant inaccuracies and/or omissions • May confuse p-values with rejection regions showing elements of both and a lack of understanding. • Attempts to find p-value or critical values for rejection region, but values may be wrong. **← No sketch included ****	Constructs a model for the given data with moderate inaccuracies and/or omissions • Choose appropriate method: P-Value or Rejection Region • Shows placement on diagram of test statistic, critical-value, alpha, p-value as appropriate for method chosen, but may have some minor errors/omissions. **** A sketch is included →**	Constructs an accurate model relating the data and clearly identifies the components of the model • Draw appropriate curve for distribution. • Choose appropriate method: P-Value or Rejection Region • Show proper placement on diagram of test statistic, critical-value, alpha value, p-value as appropriate for method chosen

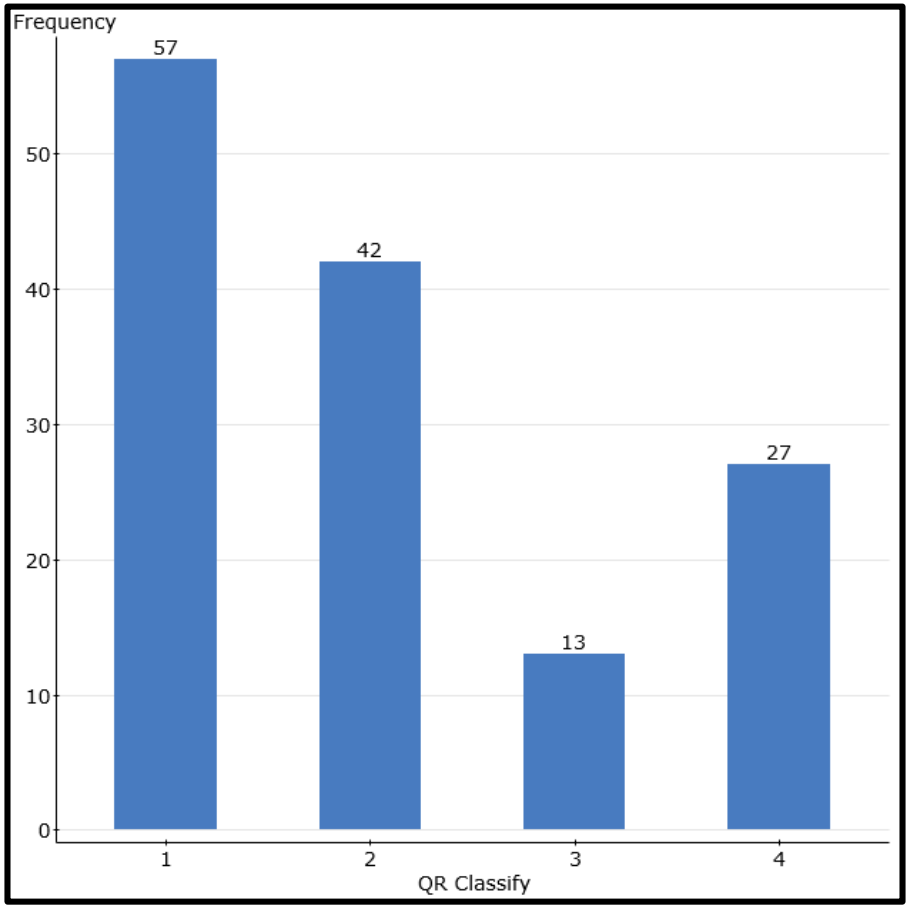
QR Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Solving using appropriate procedures **#3A Compares values for Chosen Statistical Test & Method**	Incorrect solution -Or- No supporting work shown -Or- Omits solution completely	Problem partially solved, little supporting work shown and/or weak evidence of an appropriate method being employed. • May attempt to calculate a p-value or find critical value, but shows lack of knowledge on how. • Shows lack of knowledge of what to do after finding p-value or critical value. • May invent values to attempt a comparison in order to find the answer.	Problem completely solved, sufficient supporting work shown with moderate inaccuracies and evidence of an appropriate method being employed. • Shows execution of p-value or critical rejection region method properly for the most part, but shows some confusion on proper comparison to come to answer.	Problem solved completely and accurately with supporting work and clear evidence of an appropriate method being employed. Symbolically or Pictorially: • If using P-value: Show comparison of p-value to Alpha • If using Rejection Region, show comparison of test statistic to critical value

QR Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Drawing well supported conclusions **#3B Reject or Fail to Reject H_o with Supporting work at the end of #3A**	Produces an incorrect conclusion with no support -Or- Omits conclusion altogether	Produces valid conclusions without supporting them -Or- Produces incorrect conclusions supported by faulty evidence #3B correct, no 3A support, or #3B incorrect w/faulty 3A support	Produces a brief summary with valid conclusions, interpreting key elements in the context of the problem #3B Correct #3A Supports conclusion, but support is not as inclusive or clear as it could be.	Produces valid conclusions that are well-supported by evidence and explanation within the context of the problem #3B Correct #3A Supports conclusion with $P \leq \alpha$ or t statistic in rejection region formed by proper t critical value.

QR1: Classify

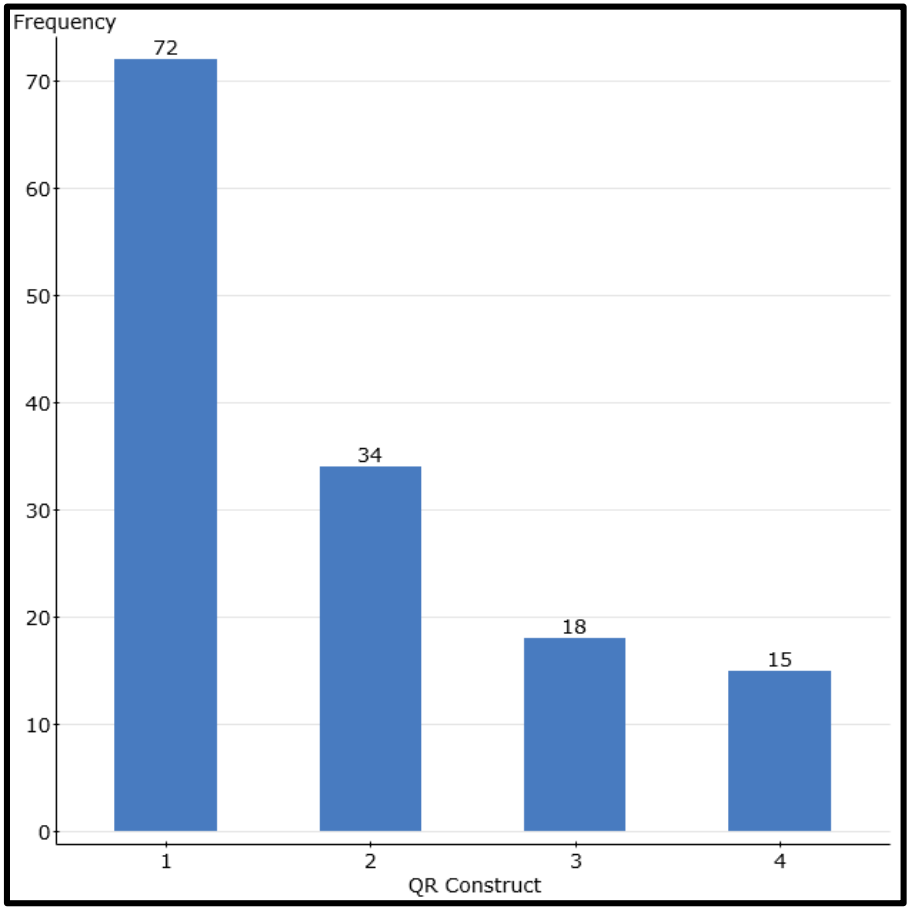


Definition: classifying and utilizing facts and formulas correctly

- **#3A: Calculates mean, SD and test statistic**

Category	QR Classify
1	41%
2	30%
3	9%
4	19%
Mean	2.07
SD	1.13

QR2: Construct

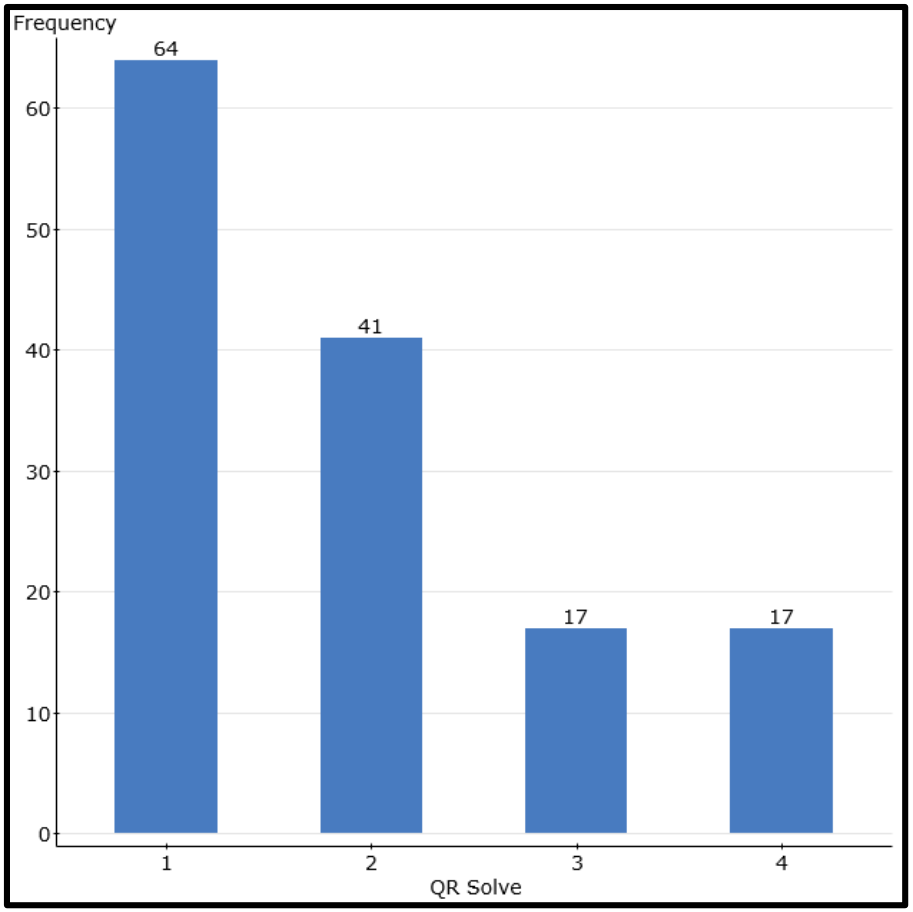


Definition: constructing a mathematical model

- **#3A: Draws Relevant Diagram**

Category	QR Construct
1	52%
2	24%
3	13%
4	11%
Mean	1.83
SD	1.03

QR3: Solve

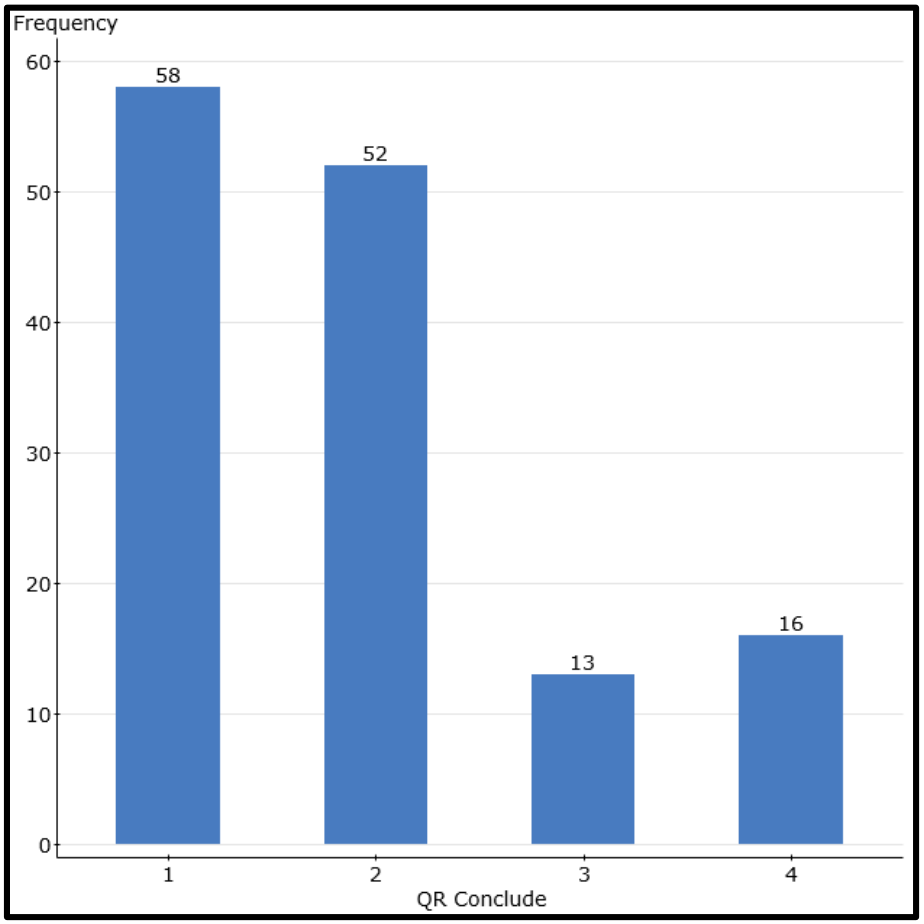


Definition: solving using appropriate procedures

- **#3A: Compares values for Chosen Statistical Test & Method**

Category	QR Solve
1	46%
2	29%
3	12%
4	12%
Mean	1.91
SD	1.03

QR4: Conclude

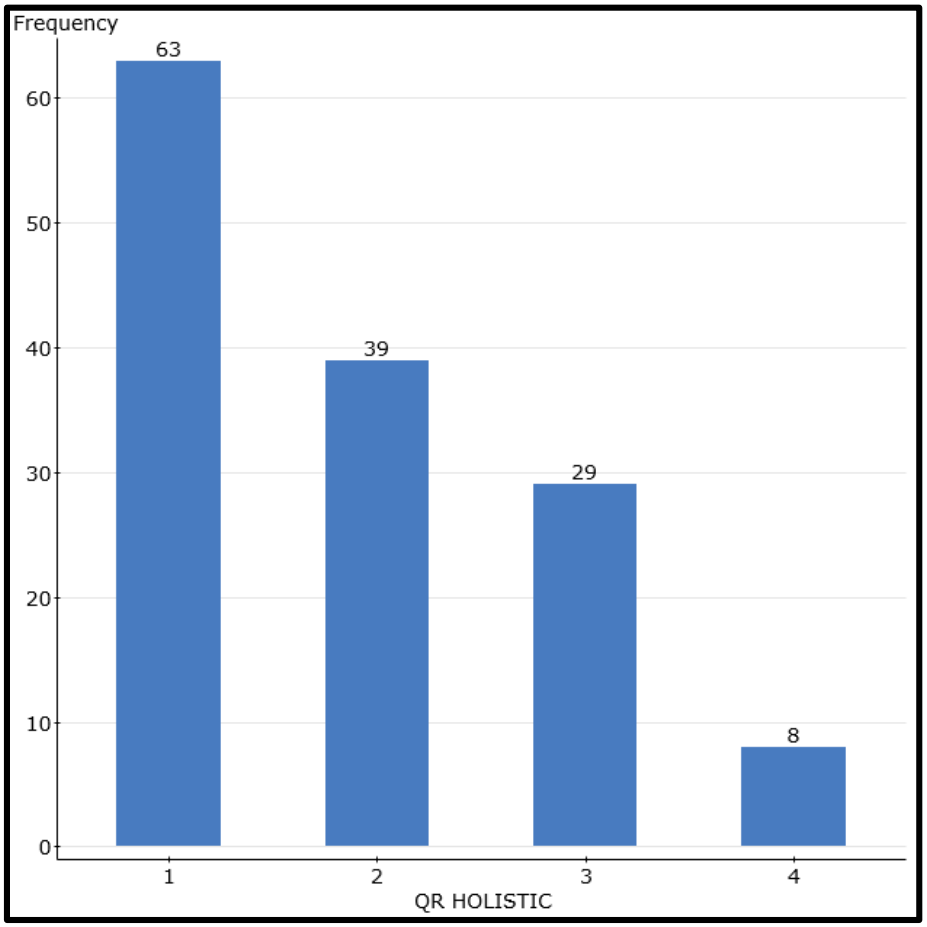


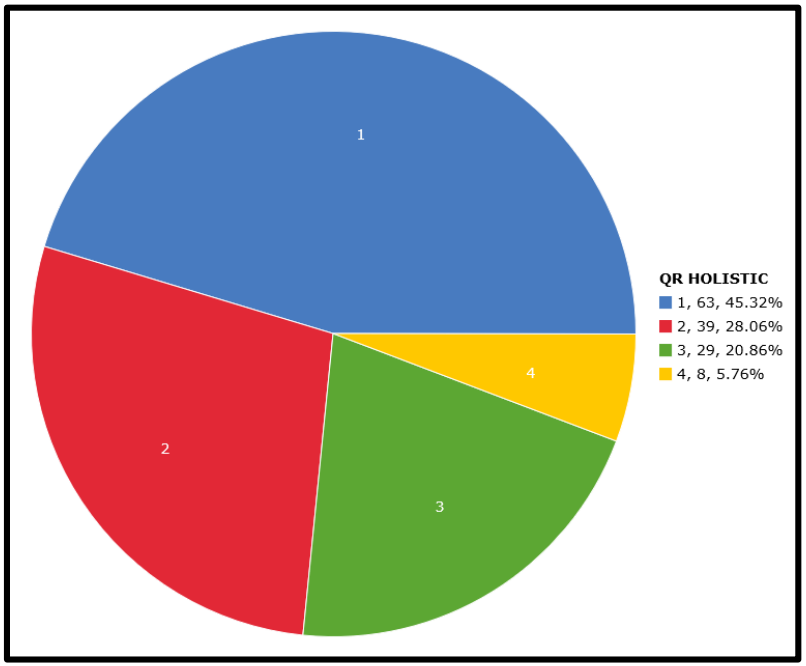
Definition: drawing well supported conclusions

- **#3B Reject or Fail to Reject Ho**

Category	QR Conclude
1	42%
2	37%
3	9%
4	12%
Mean	1.91
SD	0.98

Quantitative Reasoning: Holistic





Category	QR HOLISTIC
1	45%
2	28%
3	21%
4	6%
Mean	1.87
SD	0.94

Critical Thinking Results

CT Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Comprehending data/information **#1 Hypotheses Stmts**	Distinguishes little or none of the key elements of the problem -Or- Incorporates much erroneous or irrelevant information.	Distinguishes some of the key elements of the problem but incorporates some erroneous or irrelevant information. • Writes correct equality and/or inequality signs without μ or mpg • Hypotheses formed correctly, but incorrectly used = and ≠, or leaves 1 (in)equality sign out. • Equality/inequality signs are correct and μ is included, but writes zero or incorrect value for mpg	Distinguishes most of the key elements of the problem and incorporates little to no erroneous or irrelevant information. • All Correct, but written in English or other language and not written using symbolic representation. • Written symbolically with 1 Small error. • Writes statements correctly, but incorrectly identifies claim being tested.	Distinguishes all of the key elements of the problem and incorporates no erroneous or irrelevant information. Acceptable Hypotheses: H_o: μ = 48 H_a: μ < 48 Or H_o: μ ≥ 48 H_a: μ < 48 Student identifies consumer group's claim as H_a

CT Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Analyzing data **#2 Testing Type Explanation & Criteria**	Analyzes data inaccurately or inappropriately -Or- Omits data altogether • Lists No Criteria for T-Test. Instead may explain about how fast and how far the cars should go, where and how far the cars should be driven.	Analyzes data with significant inaccuracies and/or omissions • Lists most criteria for T-Test, but does not give support from problem • Lists 1 or 2 criteria with support, but missing other criteria	Analyzes data with moderate inaccuracies and/or omissions • Lists all criteria for T-Test, but has missing or incorrect support for some criteria.	Analyzes data accurately • Correctly discusses all of the following: -Random Sampling -Independent Sampling -Normality (via statement, sample size, CLT or graphical display) • May also include other criteria such as: Pop. Std. Dev. (σ) 10% condition

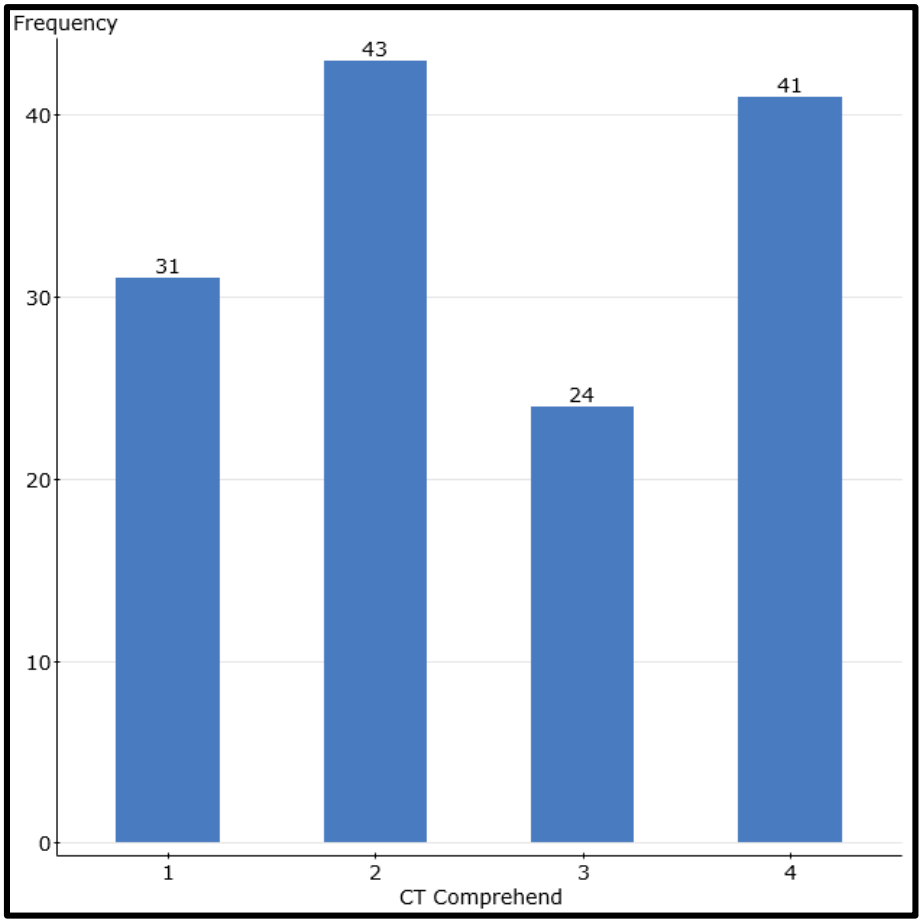
CT Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Developing a viable solution plan **#2 Testing Type Explanation & Criteria and/or #3a**	Demonstrates the development of a solution plan that is completely inappropriate or inconsistent with given data -Or- Omits plan altogether • Chooses very inappropriate statistical test, such as a 2-sample test, etc. • Chooses non-statistical test, such as "Test the Battery" or "Check Octane Level" • Chooses z or t but no criteria are discussed	Demonstrates the development of a solution plan with significant inaccuracies and/or omissions • Chooses Z-Test instead of T-Test despite listed criteria that would indicate T-Test • Chooses T-Test, but has criteria above that would indicate otherwise.	Demonstrates the development of an appropriate solution plan with moderate inaccuracies and/or omissions • Chooses 1-Sample T-Test based on listed criteria that supports this choice, but with **either** incorrect selection of **or** without stating explicitly or demonstrating correct selection of "left", "right" or "2-tail" test • Incorrectly Chooses 1-Sample Z-Test, but listed correct criteria to support the choice.	Accurately and explicitly demonstrates the development of an appropriate solution plan • Chooses 1-Sample T-Test from listed criteria that supports this choice. • Also discusses selection of "left", "right" or "2-tail" test that correctly matches stated hypotheses.

CT Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Drawing well supported conclusions **#4 Conclusion & Interpretation** **#4a and #4b**	Produces an incorrect conclusion with no support -Or- Omits conclusion altogether	Produces valid conclusions without supporting them -Or- Produces incorrect conclusions supported by faulty evidence • Conclusion has some correct elements, but is missing 2 or more parts listed in Level 4 • Correct conclusion but with no written support in #3a	Produces a brief summary, interpreting key elements in the context of the problem • Correct and includes most parts listed in Level 4 • May be missing 1 part, such as alpha level or mention of SUV/mpg. • Shows some support in #3a for conclusion	Produces conclusions that are well-supported by evidence and explanation within the context of the problem #4a and #4b are answered correctly and #4a includes: • α level • Appropriate language eg. “there is/is not enough evidence to…” • Consistency w/ Part #3 findings and work. • Discusses the claim being tested, refers to SUV & mpg

CT1: Comprehend

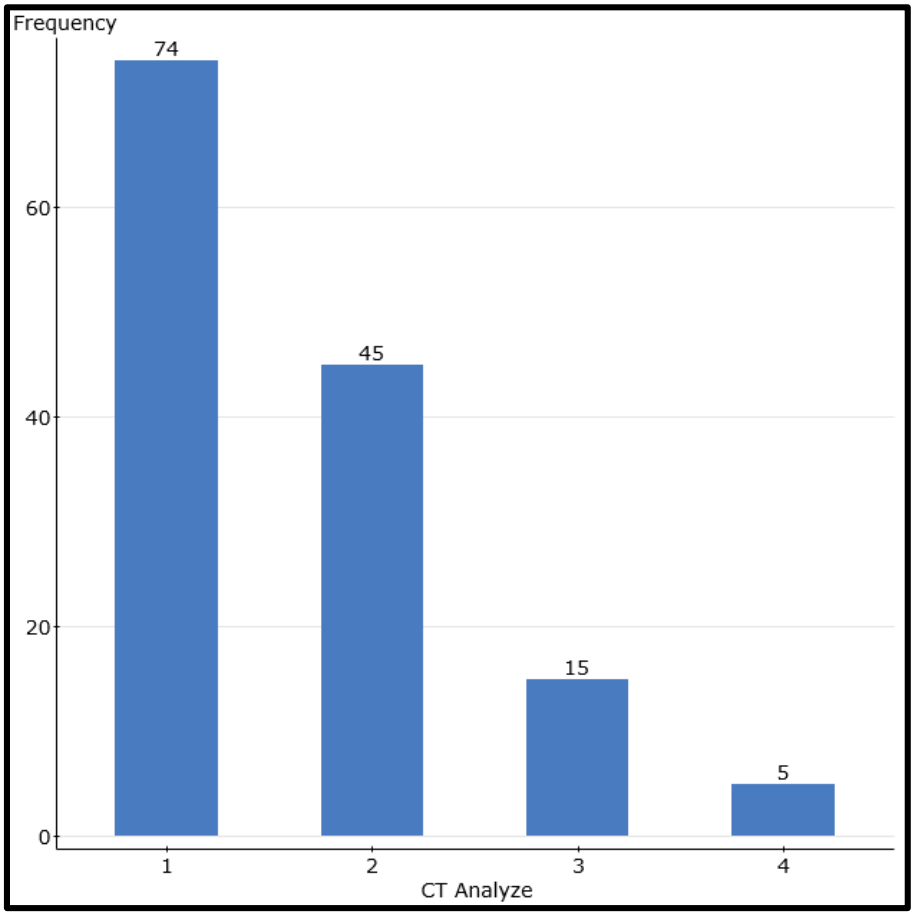


Definition: comprehending data/information

- **#1: Hypotheses Statements**

Category	CT Comprehend
1	22%
2	31%
3	17%
4	29%
Mean	2.54
SD	1.14

CT2: Analyze

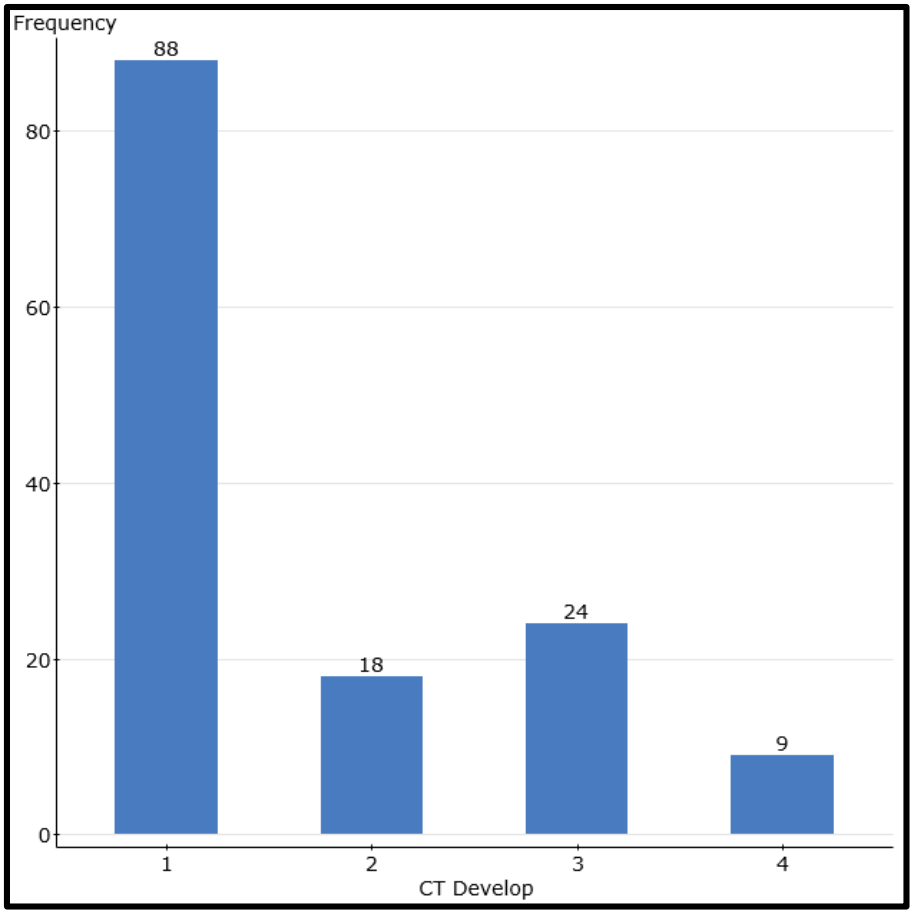


Definition: analyzing data

- **#2: Testing Type Explanation & Criteria (Conditions)**

Category	CT Analyze
1	53%
2	32%
3	11%
4	4%
Mean	1.65
SD	0.82

CT3: Develop

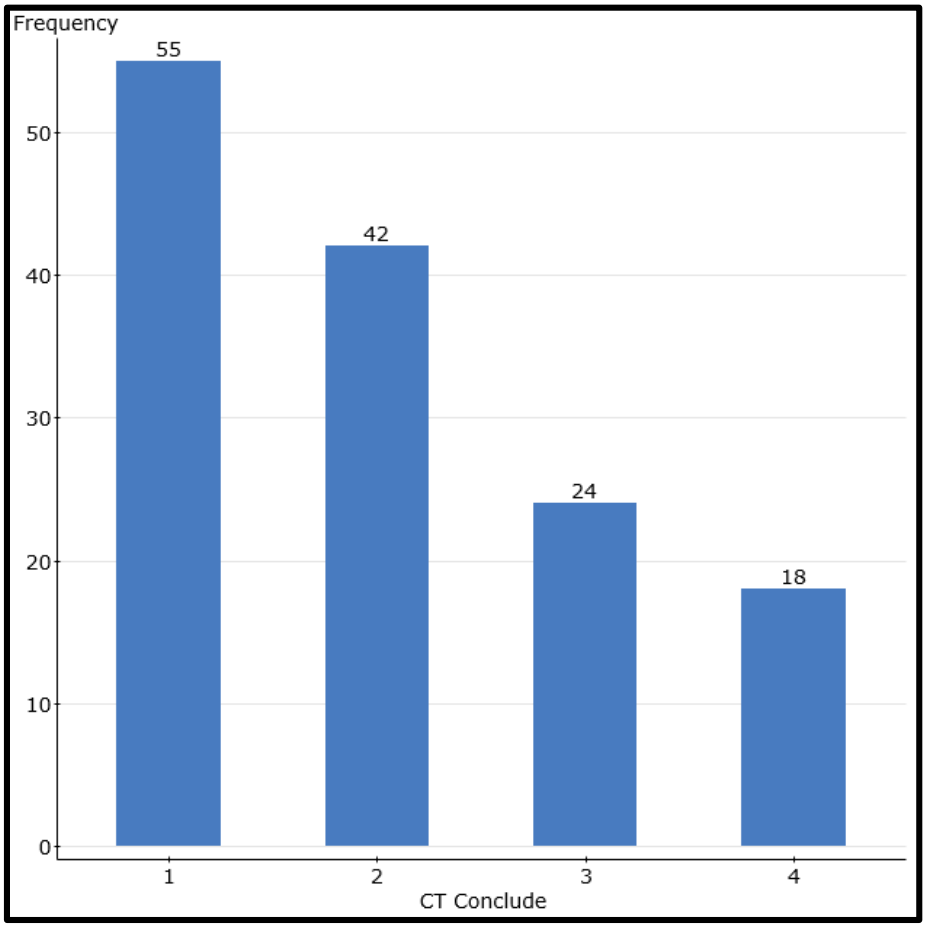


Definition: developing a viable solution plan

- **#2: Testing Type Explanation & Criteria**

Category	CT Develop
1	63%
2	13%
3	17%
4	6%
Mean	1.67
SD	0.98

CT4: Conclude

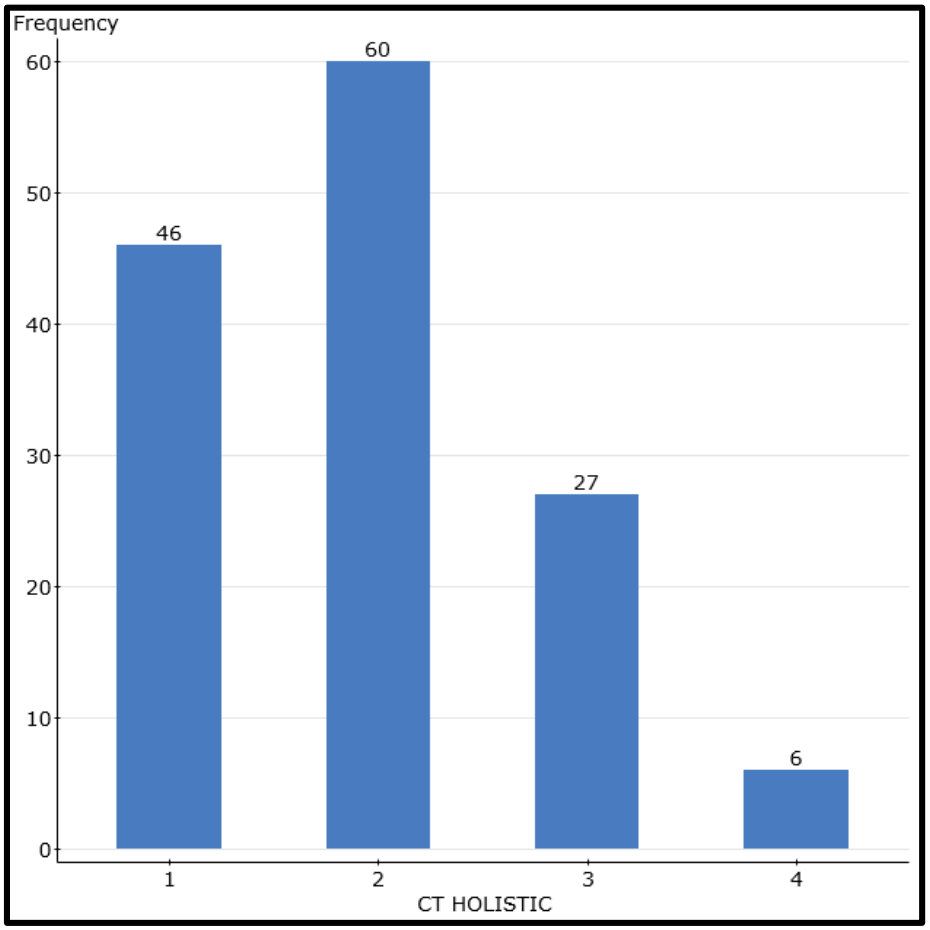


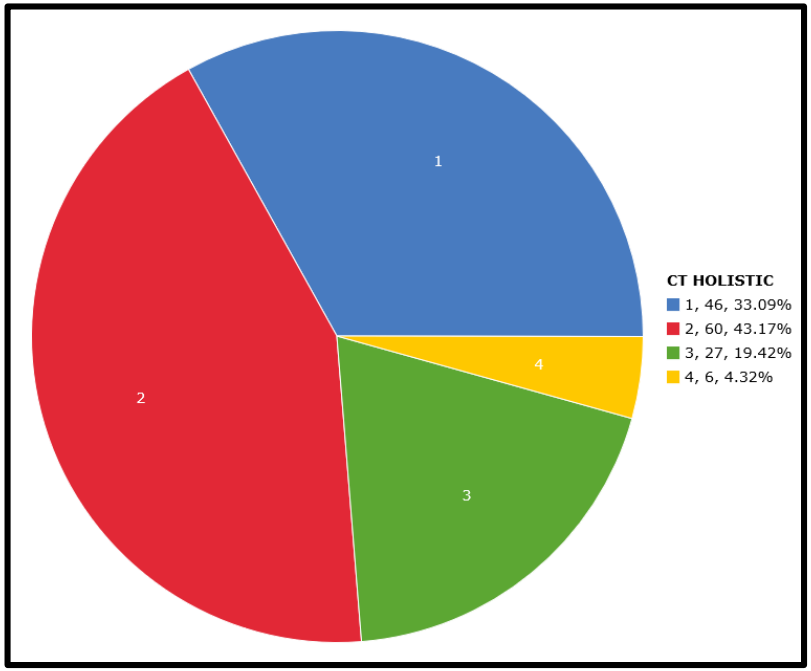
Definition: drawing well supported conclusions

- **#4: Conclusion & Interpretation**

Category	CT Conclude
1	40%
2	30%
3	17%
4	13%
Mean	2.04
SD	1.05

Critical Thinking: Holistic



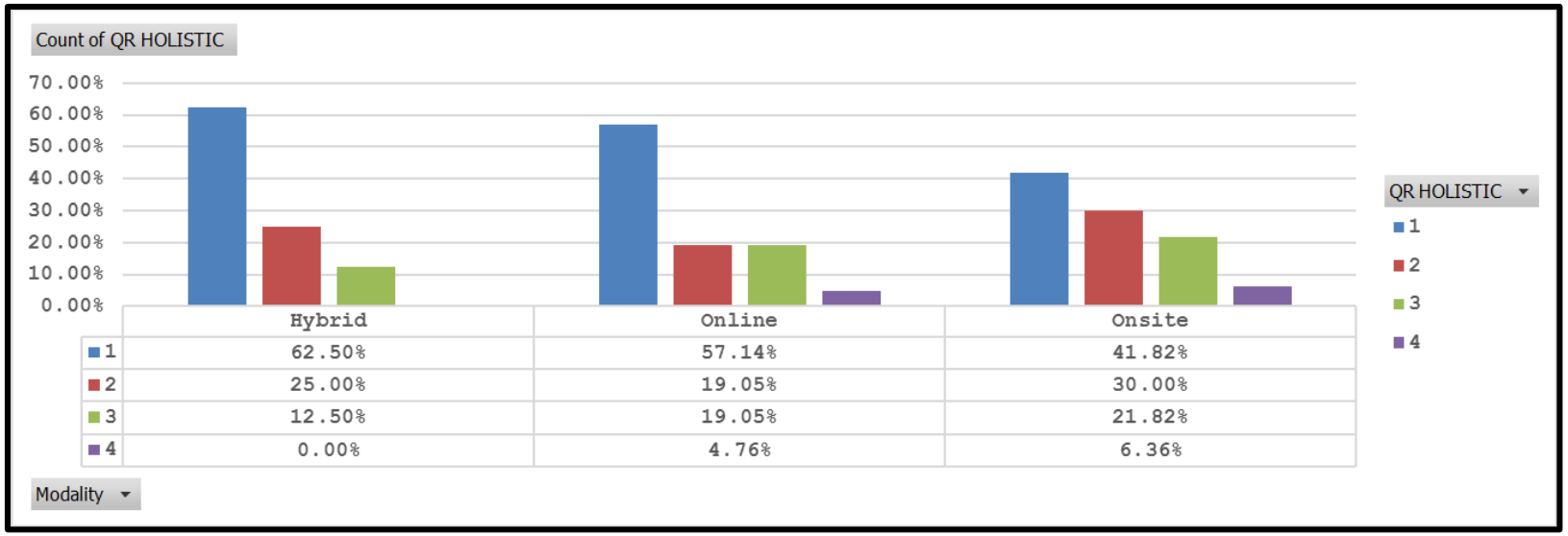


Category	CT HOLISTIC
1	33%
2	43%
3	19%
4	4%
Mean	1.95
SD	0.84

QR & CT Holistic Scores Comparison Results

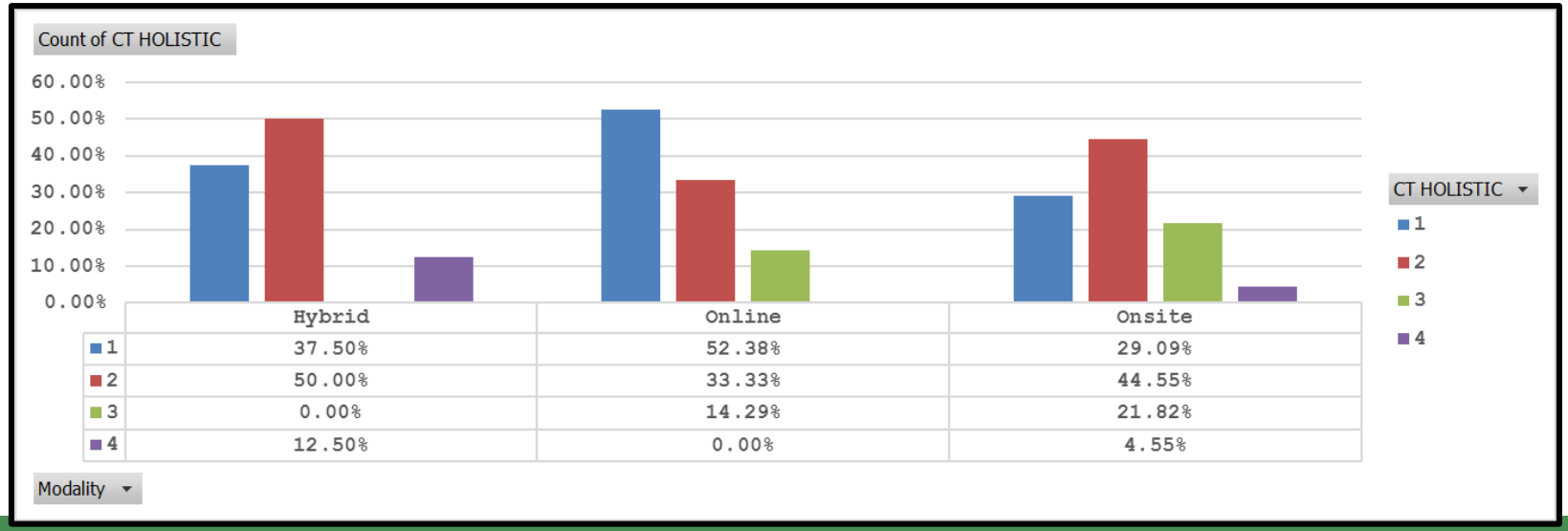
QR & CT Holistic Scores Comparison: Mode of Delivery

QR



	Hybrid	Online	Onsite
1	62.50%	57.14%	41.82%
2	25.00%	19.05%	30.00%
3	12.50%	19.05%	21.82%
4	0.00%	4.76%	6.36%

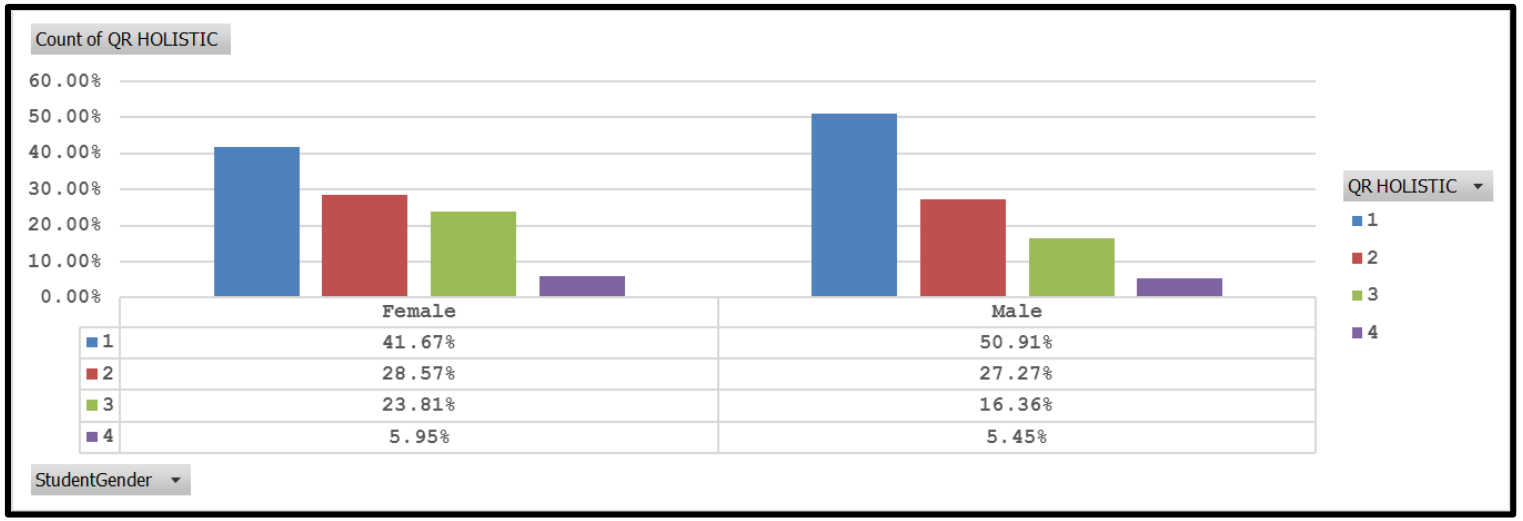
CT



	Hybrid	Online	Onsite
1	37.50%	52.38%	29.09%
2	50.00%	33.33%	44.55%
3	0.00%	14.29%	21.82%
4	12.50%	0.00%	4.55%

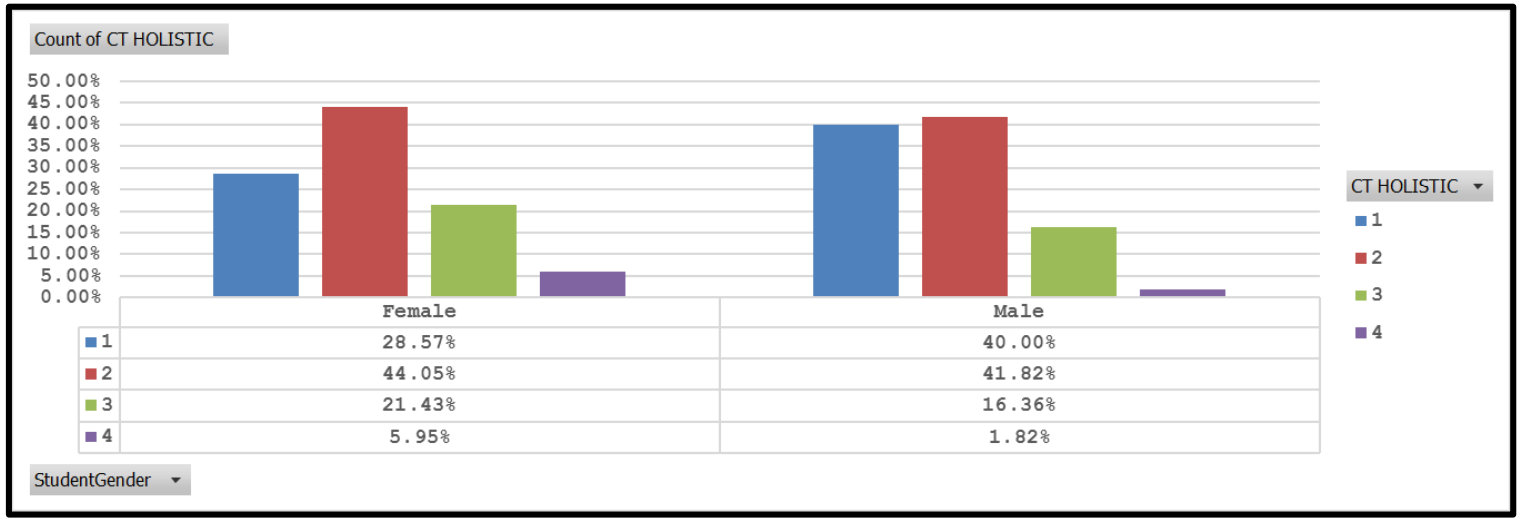
QR & CT Holistic Scores Comparison: Gender

QR



	Female	Male
1	41.67%	50.91%
2	28.57%	27.27%
3	23.81%	16.36%
4	5.95%	5.45%

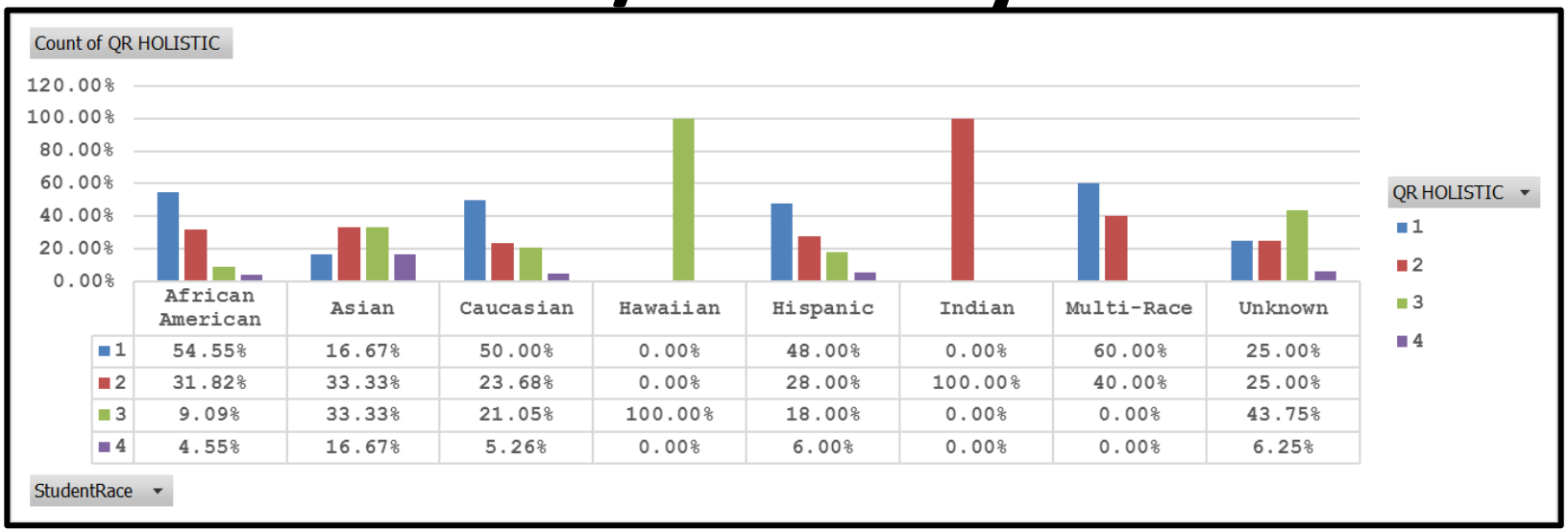
CT



	Female	Male
1	28.57%	40.00%
2	44.05%	41.82%
3	21.43%	16.36%
4	5.95%	1.82%

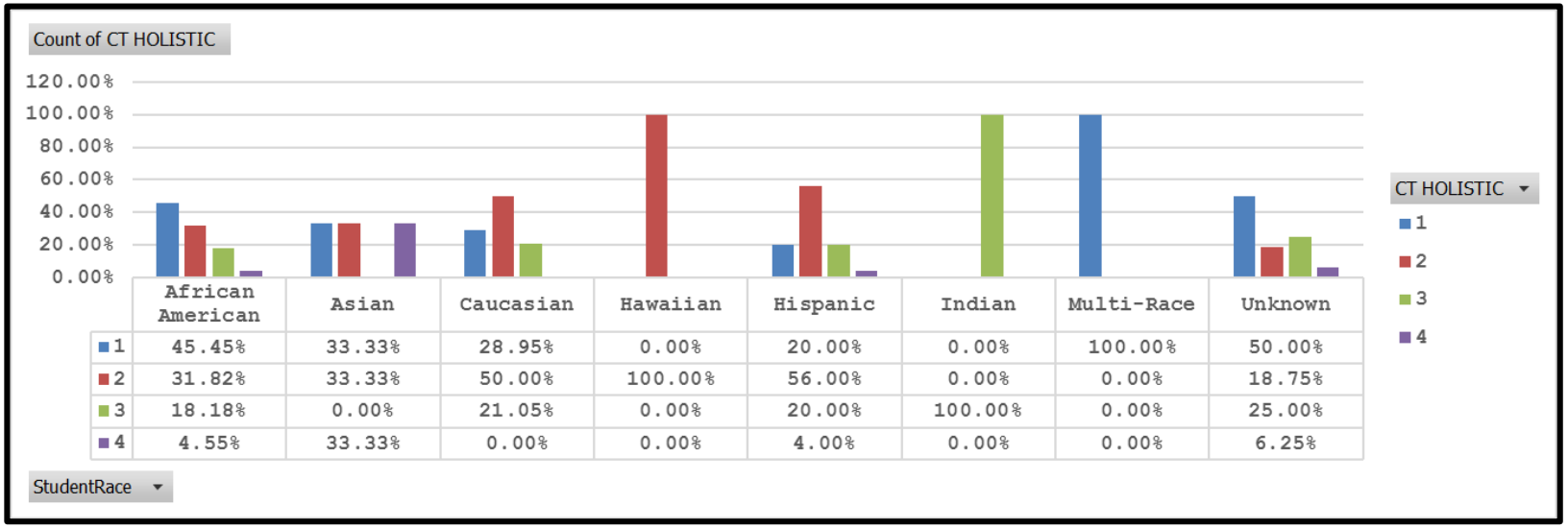
QR & CT Holistic Scores Comparison: Race/Ethnicity

QR



	African American	Asian	Caucasian	Hawaiian	Hispanic	Indian	Multi-Race	Unknown
1	54.55%	16.67%	50.00%	0.00%	48.00%	0.00%	60.00%	25.00%
2	31.82%	33.33%	23.68%	0.00%	28.00%	100.00%	40.00%	25.00%
3	9.09%	33.33%	21.05%	100.00%	18.00%	0.00%	0.00%	43.75%
4	4.55%	16.67%	5.26%	0.00%	6.00%	0.00%	0.00%	6.25%

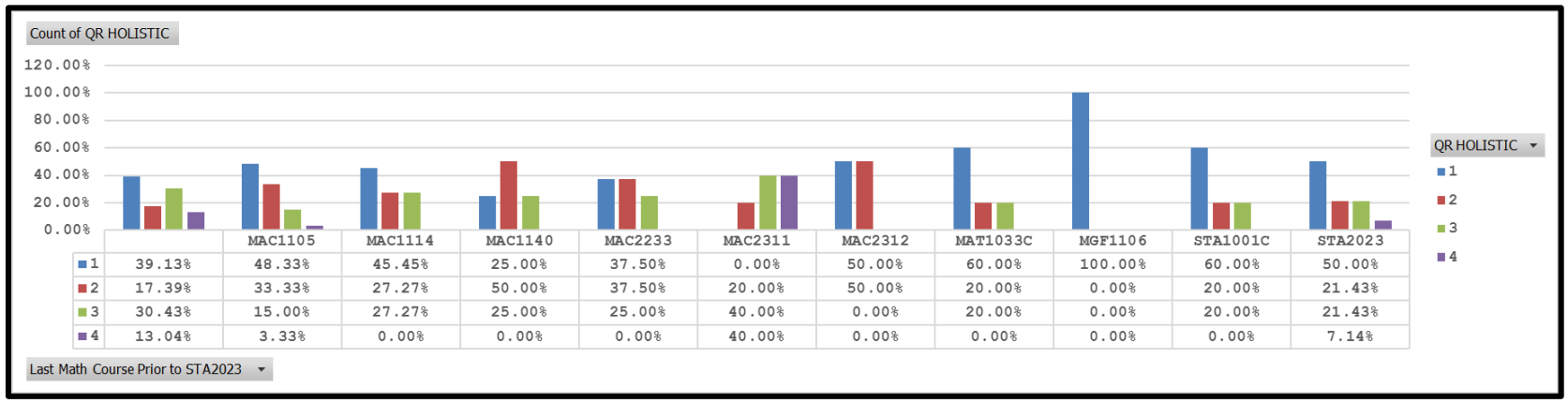
CT



	African American	Asian	Caucasian	Hawaiian	Hispanic	Indian	Multi-Race	Unknown
1	45.45%	33.33%	28.95%	0.00%	20.00%	0.00%	100.00%	50.00%
2	31.82%	33.33%	50.00%	100.00%	56.00%	0.00%	0.00%	18.75%
3	18.18%	0.00%	21.05%	0.00%	20.00%	100.00%	0.00%	25.00%
4	4.55%	33.33%	0.00%	0.00%	4.00%	0.00%	0.00%	6.25%

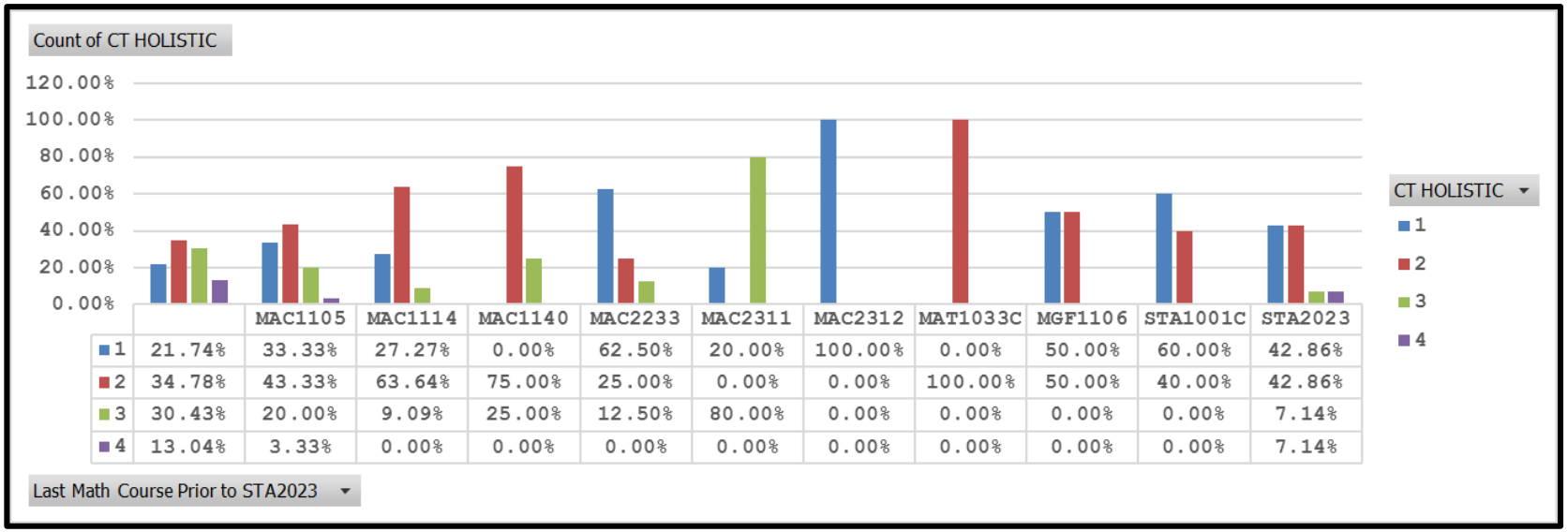
QR & CT Holistic Scores Comparison: Most Recent Math Course

QR



	MAC1105	MAC1114	MAC1140	MAC2233	MAC2311	MAC2312	MAT1033C	MGF1106	STA1001C	STA2023
1	39.13%	48.33%	45.45%	25.00%	37.50%	0.00%	50.00%	60.00%	100.00%	60.00%	50.00%
2	17.39%	33.33%	27.27%	50.00%	37.50%	20.00%	50.00%	20.00%	0.00%	20.00%	21.43%
3	30.43%	15.00%	27.27%	25.00%	25.00%	40.00%	0.00%	20.00%	0.00%	20.00%	21.43%
4	13.04%	3.33%	0.00%	0.00%	0.00%	40.00%	0.00%	0.00%	0.00%	0.00%	7.14%

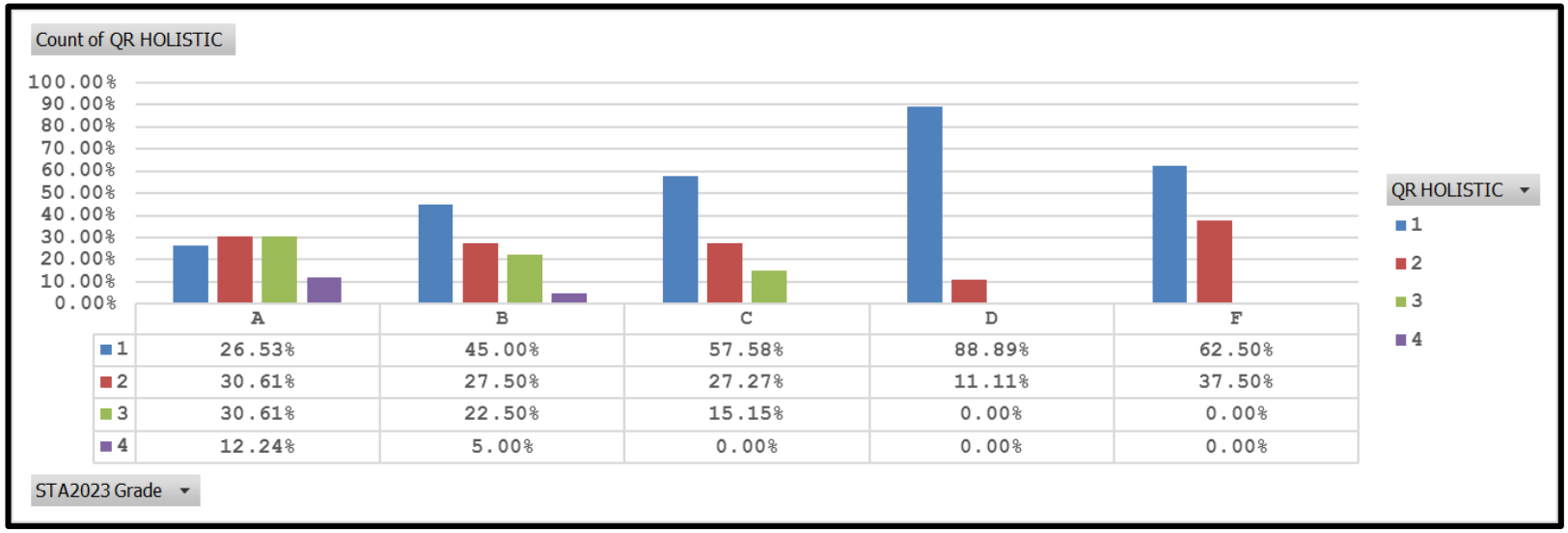
CT



	MAC1105	MAC1114	MAC1140	MAC2233	MAC2311	MAC2312	MAT1033C	MGF1106	STA1001C	STA2023
1	21.74%	33.33%	27.27%	0.00%	62.50%	20.00%	100.00%	0.00%	50.00%	60.00%	42.86%
2	34.78%	43.33%	63.64%	75.00%	25.00%	0.00%	0.00%	100.00%	50.00%	40.00%	42.86%
3	30.43%	20.00%	9.09%	25.00%	12.50%	80.00%	0.00%	0.00%	0.00%	0.00%	7.14%
4	13.04%	3.33%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.14%

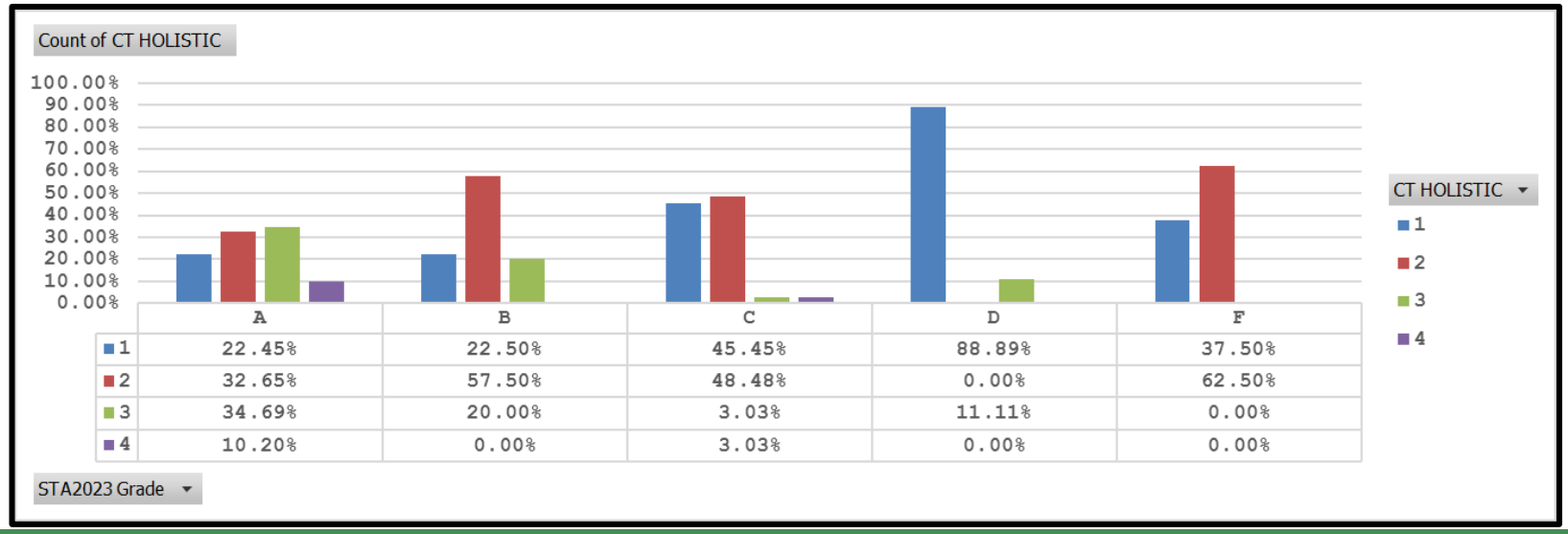
QR & CT Holistic Scores Comparison: STA 2023 Final Grade

QR



	A	B	C	D	F
1	26.53%	45.00%	57.58%	88.89%	62.50%
2	30.61%	27.50%	27.27%	11.11%	37.50%
3	30.61%	22.50%	15.15%	0.00%	0.00%
4	12.24%	5.00%	0.00%	0.00%	0.00%

CT



	A	B	C	D	F
1	22.45%	22.50%	45.45%	88.89%	37.50%
2	32.65%	57.50%	48.48%	0.00%	62.50%
3	34.69%	20.00%	3.03%	11.11%	0.00%
4	10.20%	0.00%	3.03%	0.00%	0.00%

Assessment Question & Rubric Refinement Discussion

STA2023 Common Final Exam Question (Fall 2016)

The manufacturer of a new hybrid sports utility vehicle (SUV) states that it gets an average of 48 miles per gallon (mpg) on the highway. A consumer group suspects that perhaps the new SUV's gas efficiency is lower than the manufacturer's statement. Assume that the gas efficiency of the SUV is approximately normally distributed. The consumer group randomly tests 13 of the new SUV's under similar highway conditions and obtains the following results:

39, 40, 41, 42, 43, 43, 44, 45, 45, 46, 47, 47, 50

STA2023 Common Final Exam Question (Fall 2016)

1a) Write the Hypotheses statements below to test the consumer group's claim:

- **Ho:**
- **Ha:**

1b) Which Hypothesis represents the consumer group's claim?

- **(Circle one: *Null Hypothesis (H_0)* or *Alternative Hypothesis (H_a)***

STA2023 Common Final Exam Question (Fall 2016)

2) **Explain what type of hypothesis testing you will perform and whether conditions are met.**

3) **Test this hypothesis using a significance level of α = 5%. (SHOW WORK!)**
   - **Include work for: <u>Clearly labeled sketch with appropriate shading</u> and <u>calculation of the test statistic</u>**

STA2023 Common Final Exam Question (Fall 2016)

3b) Would you reject or fail to reject the null hypothesis?

- **(Circle one: *Reject H_0* or *Fail to Reject H_o*)**

4a) Using a significance level of α = 5%, write a conclusion in the context of this problem:

4b) A friend is looking for an SUV that averages 48 mpg or more on the highway. Would you advise your friend to purchase this new model SUV?

- **(Circle one: YES or NO)**

QR Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Classifying and utilizing facts and formulas correctly **#3A: Calculates mean, std. dev. and test statistic**	Utilizes mathematical facts and formulas incorrectly or inappropriately -Or- Omits them altogether • May calculate irrelevant information or • May show significant lack of knowledge in the calculation of relevant information.	Utilizes mathematical facts and formulas with significant inaccuracies and/or omissions In calculating mean, standard deviation and test statistic, • leaves one out completely and/or • makes significant errors on most of them.	Utilizes mathematical facts and formulas with moderate inaccuracies and/or omissions For the most part, correctly calculates mean, test statistic, and standard deviation, but may have: • used σ instead of s • mean incorrect due to omitted/incorrect value. • test statistic work partially incorrect • Correct values, but no work shown.	Utilizes mathematical facts and formulas accurately Calculates correctly & shows work (by-hand or calculator function) for: • Mean • Sample Std. Dev. • Test Statistic consistent with test choice in #2 • If using calculator, should note somewhere “1-Var Stats”

QR Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Constructing a mathematical model **#3A Draws Relevant Diagram or otherwise organizes relevant information.**	Constructs an incomplete or inappropriate model for the given data -Or- Omits model completely	Constructs a model for the given data with significant inaccuracies and/or omissions • May confuse p-values with rejection regions showing elements of both and a lack of understanding. • Attempts to find p-value or critical values for rejection region, but values may be wrong.	Constructs a model for the given data with moderate inaccuracies and/or omissions • Choose appropriate method: P-Value or Rejection Region • Shows placement on diagram of test statistic or critical-value and alpha or p-value as appropriate for method chosen, but may have some minor errors/omissions.	Constructs an accurate model relating the data and clearly identifies the components of the model • Draw appropriate curve for distribution. • Choose appropriate method: P-Value or Rejection Region • Show proper placement on diagram of test statistic or critical-value and alpha value or p-value as appropriate for method chosen
	← No sketch included **		**** A sketch is included →**	

QR Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Solving using appropriate procedures **#3A Compares values for Chosen Statistical Test & Method**	Incorrect solution -Or- No supporting work shown -Or- Omits solution completely	Problem partially solved, little supporting work shown and/or weak evidence of an appropriate method being employed. • May attempt to calculate a p-value or find critical value, but shows lack of knowledge on how. • Shows lack of knowledge of what to do after finding p-value or critical value. • May invent values to attempt a comparison in order to find the answer.	Problem completely solved, sufficient supporting work shown with moderate inaccuracies and evidence of an appropriate method being employed. • Shows execution of p-value or critical rejection region method properly for the most part, but shows some confusion on proper comparison to come to answer.	Problem solved completely and accurately with supporting work and clear evidence of an appropriate method being employed. Symbolically or Pictorially: • If using P-value: Show comparison of p-value to Alpha • If using Rejection Region, show comparison of test statistic to critical value

QR Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Drawing well supported conclusions **#3B Reject or Fail to Reject H_o with Supporting work at the end of #3A**	Produces an incorrect conclusion with no support -Or- Omits conclusion altogether	Produces valid conclusions without supporting them -Or- Produces incorrect conclusions supported by faulty evidence #3B correct, no 3A support, or #3B incorrect w/faulty 3A support	Produces a brief summary with valid conclusions, interpreting key elements in the context of the problem #3B Correct #3A Supports conclusion, but support is not as inclusive or clear as it could be.	Produces valid conclusions that are well-supported by evidence and explanation within the context of the problem #3B Correct #3A Supports conclusion with $P \leq \alpha$ or t statistic in rejection region formed by proper t critical value.

CT Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Comprehending Data or Information **#1 Hypotheses Statements**	Distinguishes little or none of the key elements of the problem -Or- Incorporates much erroneous or irrelevant information.	Distinguishes some of the key elements of the problem but incorporates some erroneous or irrelevant information. • Writes correct equality and/or inequality signs without μ or mpg • Hypotheses formed correctly, but incorrectly used = and ≠, or leaves 1 (in)equality sign out. • Equality/inequality signs are correct and μ is included, but writes zero or incorrect value for mpg	Distinguishes most of the key elements of the problem and incorporates little to no erroneous or irrelevant information. • All Correct, but written in English or other language and not written using symbolic representation. • Written symbolically with 1 Small error. • Writes statements correctly, but incorrectly identifies claim being tested.	Distinguishes all of the key elements of the problem and incorporates no erroneous or irrelevant information. Acceptable Hypotheses: H_o: μ = 48 H_a: μ < 48 Or H_o: μ ≥ 48 H_a: μ < 48 Student identifies consumer group's claim as H_a

CT Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4

Analyzing data
 	
#2 Testing Type Explanation & Criteria
	Analyzes data inaccurately or inappropriately
	-Or-
	Omits data altogether
	
	• Lists No Criteria for T-Test. Instead may explain about how fast and how far the cars should go, where and how far the cars should be driven.
		Analyzes data with significant inaccuracies and/or omissions
		
		• Lists most criteria for T-Test, but does not give support from problem
		
		• Lists 1 or 2 criteria with support, but missing other criteria
			Analyzes data with moderate inaccuracies and/or omissions
			
			• Lists all criteria for T-Test, but has missing or incorrect support for some criteria.
				Analyzes data accurately
				
				• Correctly discusses all of the following:
				  • Random Sampling
				  • Independent Sampling
				  • Normality (via statement, sample size, CLT or graphical display)
				• May also include other criteria such as:
				  • Pop. Std. Dev. (σ)
				  • 10% condition

CT Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Developing a viable solution plan **#2 Testing Type Explanation & Criteria and/or #3a**	Demonstrates the development of a solution plan that is completely inappropriate or inconsistent with given data -Or- Omits plan altogether • Chooses very inappropriate statistical test, such as a 2-sample test, etc. • Chooses non-statistical test, such as "Test the Battery" or "Check Octane Level" • Chooses z or t but no criteria are discussed	Demonstrates the development of a solution plan with significant inaccuracies and/or omissions • Chooses Z-Test instead of T-Test despite listed criteria that would indicate T-Test • Chooses T-Test, but has criteria above that would indicate otherwise.	Demonstrates the development of an appropriate solution plan with moderate inaccuracies and/or omissions • Chooses 1-Sample T-Test based on listed criteria that supports this choice, but with either incorrect selection of or without stating explicitly or demonstrating correct selection of "left", "right" or "2-tail" test • Incorrectly Chooses 1-Sample Z-Test, but listed correct criteria to support the choice.	Accurately and explicitly demonstrates the development of an appropriate solution plan • Chooses 1-Sample T-Test from listed criteria that supports this choice. • Also discusses selection of "left", "right" or "2-tail" test that correctly matches stated hypotheses.

CT Rubric

Performance Indicators	Beginning Level 1	Developing Level 2	Competent Level 3	Accomplished Level 4
Drawing well supported conclusions **#4 Conclusion & Interpretation** **#4a and #4b**	Produces an incorrect conclusion with no support -Or- Omits conclusion altogether	Produces valid conclusions without supporting them -Or- Produces incorrect conclusions supported by faulty evidence • Conclusion has some correct elements, but is missing 2 or more parts listed in Level 4 • Correct conclusion but with no written support in #3a	Produces a brief summary, interpreting key elements in the context of the problem • Correct and includes most parts listed in Level 4 • May be missing 1 part, such as alpha level or mention of SUV/mpg. • Shows some support in #3a for conclusion	Produces conclusions that are well-supported by evidence and explanation within the context of the problem #4a and #4b are answered correctly and #4a includes: • α level • Appropriate language eg. “there is/is not enough evidence to...” • Consistency w/ Part #3 findings and work. • Discusses the claim being tested, refers to SUV & mpg

Other Topics

- Different textbooks - does that affect student performance? (Misty)
- Instructors should not manipulate the question (Jon & Mary)
- Mary & Jon have volunteered to continue to serve as LoLs
- Other

Path Ahead

- Increased sample size for next iteration
  - Will need more scorers
- Will distribute refined question and rubrics to group
  - Please review
- Xitracs information to be inputted NLT May 22 by Jon & Mary
- Determination of permanent LoL personnel