SMART ASSESSMENT – TWO BIRDS WITH ONE STONE

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MATH 1090 Quant Reasoning With Statistics

- Redesigned as part of EO 1110 - focus on students as critical consumers of statistics
- Mastery-based grading using rubrics
  - 2 midterms
  - several labs that incorporate stats software
  - 3-part project that spans the semester
  - Optional Final (re-assessment)
- 80 sections with 37 instructors in Fall 2018
- 16 sections with 8 instructors in Spring 2019

Take 1: Fall 2018

Four Broad Standards:

Where Does Data Come From??

How Can We Best Organize Data?

How Do We Describe Chance?

How Can We Draw Conclusions About Data?

Rubric – Example Data Analysis

Data Analysis Lab and Midterm Rubric

Criteria	Ratings							Pts
Conceptual Knowledge Shows understanding by - reading off information from bar charts and other types of charts - accurately describing distributions and/or making connections to mean, median, and variation - correctly identifying type (linear or not, positive or negative) and strength (via correlation coefficient) of correlation from a scatter plot	6.0 pts **Exceeds Mastery** Demonstrates understanding completely and correctly	5.0 pts **Exceeds/Meets Mastery** In Between Exceeds and Meets	4.0 pts **Meets Mastery** Demonstrates understanding with only minor mistakes.	3.0 pts **Meets/Near Mastery** In Between Meets and Near	2.0 pts **Near Mastery** Demonstrates partial understanding is partial and/or with major mistakes.	1.0 pts **Well Below Mastery** Understanding is not demonstrated and/or work is missing or incomplete.	0.0 pts **Not Assessible** Insufficient work provided to be assessed.	6.0 pts
Procedural Knowledge Able to Accurately: – create graphics such as line graphs and bar charts including labels (titles and axes) - create graphs of distributions - create scatterplots - show knowledge of properties of the normal distributions - follow directions in assignment	6.0 pts **Exceeds Mastery** Demonstrates procedural knowledge with precision and thoroughness.	5.0 pts **Exceeds/Meets** In Between Exceeds and Meets	4.0 pts **Meets Mastery** Demonstrates procedural knowledge with only minor mistakes.	3.0 pts **Meets/Near Mastery** In between Meets and Near	2.0 pts **Near Mastery** Procedural knowledge may have major mistakes and/or some lack of completeness.	1.0 pts **Well Below Mastery** Does not demonstrate procedural knowledge and/or incomplete work.	0.0 pts **Not Assessible** Insufficient work provided to be assessed.	6.0 pts
Communication Records procedures, sketches graphs and distributions and explains reasoning clearly and completely using mathematical language (e.g., data, axes) and appropriate vocabulary.	6.0 pts **Exceeds Mastery** Communicates precisely and thoroughly.	5.0 pts **Exceeds/Meets Mastery** In between Exceeds and Meets	4.0 pts **Meets Mastery** Communicates clearly with only minor mistakes.	3.0 pts **Meets/Near Mastery** In between Meets and Near	2.0 pts **Near Mastery** Communicates with partial clarity and possible missing pieces.	1.0 pts **Well Below Mastery** Communication is unclear with major missing components.	0.0 pts **Not Assessible** Insufficient work provided to be assessed.	6.0 pts

3 components &
6 levels

Lack of clarity for both students and instructors



Image from https://www.shutterstock.com/search/rethinking

Take 2: Spring 2019

24 Focused Standards:



Examples of Standards

- **D3**: Describe, use and identify different types of statistical studies, including observational study, experiment, census, and sample survey.
- **I7**: Set up hypothesis tests for means and use them to support or reject claims about population means, including comparing P-values and confidence levels.
- **CR3**: Use both graphical and numerical summary statistics to draw conclusions about a data set or to compare different data sets. Properly use sample statistics to draw conclusions about the population, recognizing any underlying assumptions or limits of the analysis. Critically analyze information in popular media and scientific articles to draw conclusions about accuracy of representation and validity.

ONE Rubric For All Standards

Score	Formal Meaning	Informal meaning	Interpretation
4 or E	Exceeds expectation – exceptional understanding	I own this! I can explain how to do this task and why it works to someone else. I can complete the task in both familiar and unfamiliar situations - I could teach it.	Student demonstrates complete understanding of the relevant concepts and solution methods. • Problems are solved correctly and completely. • Concepts are applied and explained correctly. • Arguments are complete, convincing and clear
3 or M	Mastered – solid understanding	I know how to do this task. I can do problems independently, but I am not quite sure why it works. I can complete this task in familiar situations with good accuracy and few mistakes.	Student demonstrates understanding of the relevant concepts and solution methods. • Solution of problems may include some algebraic or conceptual errors, but they are minor. • Arguments are mostly complete, but may have some omissions of details
2 or N	Near Mastery – basic understanding	I do not quite understand how to do this, task and need to look at examples to complete the problem. I can complete the basics of this task in familiar situations only.	Student demonstrates partial understanding of the relevant concepts and solution methods. • Problem solutions contain a fundamental error, conceptual misunderstanding, or the solution is incomplete. • Arguments are only partially correct or are unclear.
1 or WB	Well below mastery – minimal understanding,	I get bits and pieces but I can't put anything together. I cannot complete this task without help.	Student demonstrates only minimal understanding of the relevant concepts and solution methods. • Problem solution has many algebraic errors or shows major conceptual misunderstandings or inappropriate statistical methods are used. • Arguments have major omissions or are unclear and incorrect.
0	Not assessible - No evidence of understanding	I have no idea what you are talking about!	Insufficient work was shown to determine the level of mastery of this standard.



How to Deal with Grading and Standardize It?

Image from https://premiergazette.com/2018/03/glenwakeman-entrepreneur-solutions/

Grading Tool & Norming Sessions

- Grading Tool - Excel template that allows automation for two reasons:
  - **Instructor work load**
  - **Course coordination and item analysis:**
    - Analysis by question or standard for individual section
    - Combining data across all sections allows for course-level assessment
- Norming sessions with sample student submissions

	CIN	Student Name
1		alex
2		barbara
3		C
4		D
5		E
6		F
7		G
8		H
9		I
10		J
11		K
12		L
13		M
14		N
15		O
16		P
17		Q
18		R
19		S
20		T
21		U
22		V
23		X
24		Y
25		Z

Lab 1 Grading Tool

		Name:	alex	barbara	C	D	E
Q4A	D3		4	1	1	4	1
Q4B	D1		2	1	1	3	1
Q4C	D2		2	1	1	3	1
Q5	D5		2	2	3	1	1
Q6 (All)	D4		2	2	1	2	1
Q6B	D5		2	2	1	1	1
Q7	D5		3	3	1	2	1
Q8	D5		1	4	1	3	1
Q9	D3		2	2	1	2	1
Q10	CR3		3	3	1	2	1

Name:			alex	barbara		C		D		E	
D1	Q2	2	2	1	1	2	1.5	2	2.5	1	1
	Q4B	2	N	1	WB	1	WB	3	N	1	WB
D2	Q3	3	2.6	3	2.2	3	2.2	1	1.8	1	1
	Q4C	2	M	1	N	1	N	3	N	1	WB
D3	Q1	4	3	4	2.25	4	1.75	4	3	1	1
	Q4A	4	M	1	N	1	N	4	M	1	WB
	Q9	2		2		1		2		1	
D4	Q6 (All)	2	N	2	N	1	WB	2	N	1	WB
D5	Q5	2	2	2	2.75	3	1.5	1	1.75	1	1
	Q6B	2	N	2	M	1	WB	1	N	1	WB
	Q7	3		3		1		2		1	
	Q8	1		4		1		3		1	
CR3	Q10	3	M	3	M	1	WB	2	N	1	WB

For Data Analysis Only					
% of Standards at E	0%	0%	0%	0%	0%
% of Standards at M	50%	33%	0%	17%	0%
% of Standards at N	50%	50%	33%	83%	0%
% of Standards at WB	0%	17%	67%	0%	100%
of standards Passed (E or N	50%	33%	0%	17%	0%
standards Not Passed (N or	50%	67%	100%	83%	100%

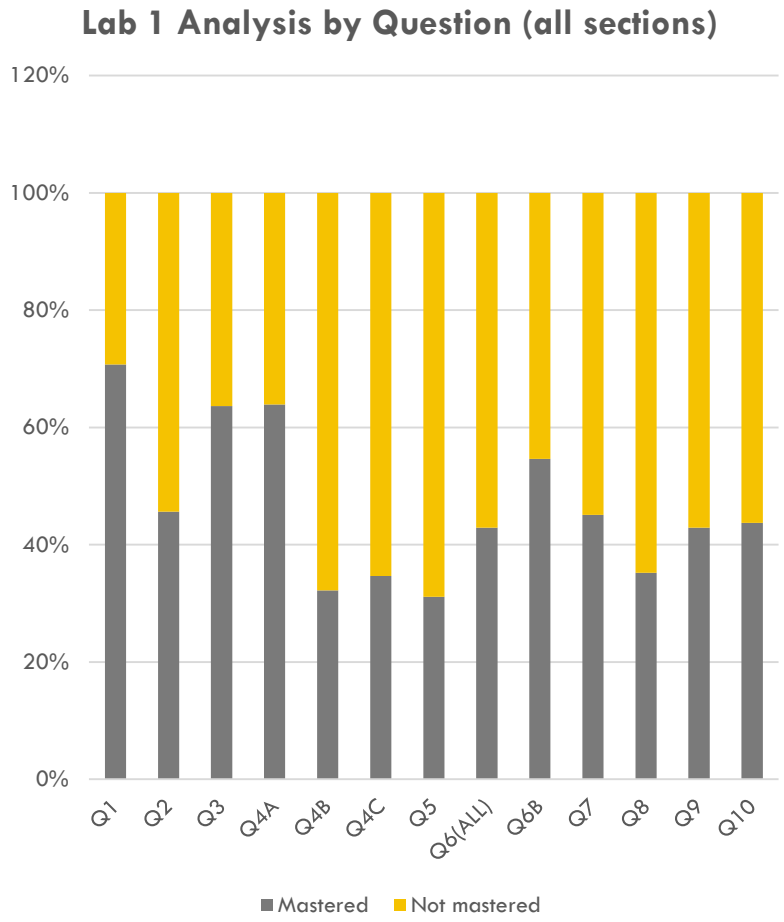
		Spring 2019	1090					
Student Number	**CIN**	**Name**	**D1**	**D2**	**D3**	**D4**	**D5**	**CR3**
1	0	alex	N	M	M	N	N	M
2	0	barbara	WB	N	N	N	M	M
3	0	C	WB	N	N	WB	WB	WB
4	0	D	N	N	M	N	N	N
5	0	E	WB	WB	WB	WB	WB	WB
6	0	F	WB	WB	WB	WB	WB	WB
7	0	G	WB	WB	WB	WB	WB	WB
8	0	H	N	N	N	N	N	WB
9	0	I	N	E	M	N	N	N
10	0	J	WB	WB	WB	WB	WB	WB
11	0	K	WB	N	N	WB	WB	WB
12	0	L	N	E	E	M	M	N
13	0	M	E	E	M	N	E	E
14	0	N	E	E	E	M	N	WB
15	0	O	N	N	N	WB	WB	WB
16	0	P	WB	WB	WB	WB	WB	WB
17	0	Q	N	N	E	N	WB	WB
18	0	R	M	M	M	E	E	N
19	0	S	M	M	M	N	N	WB
20	0	T	N	N	E	N	N	WB
21	0	U	M	M	N	M	N	WB
22	0	V	N	N	E	N	WB	M
23	0	W	N	N	M	N	WB	N
24	0	X	WB	M	M	M	N	E
25	0	Y	WB	WB	WB	WB	WB	WB
26	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0
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29	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0

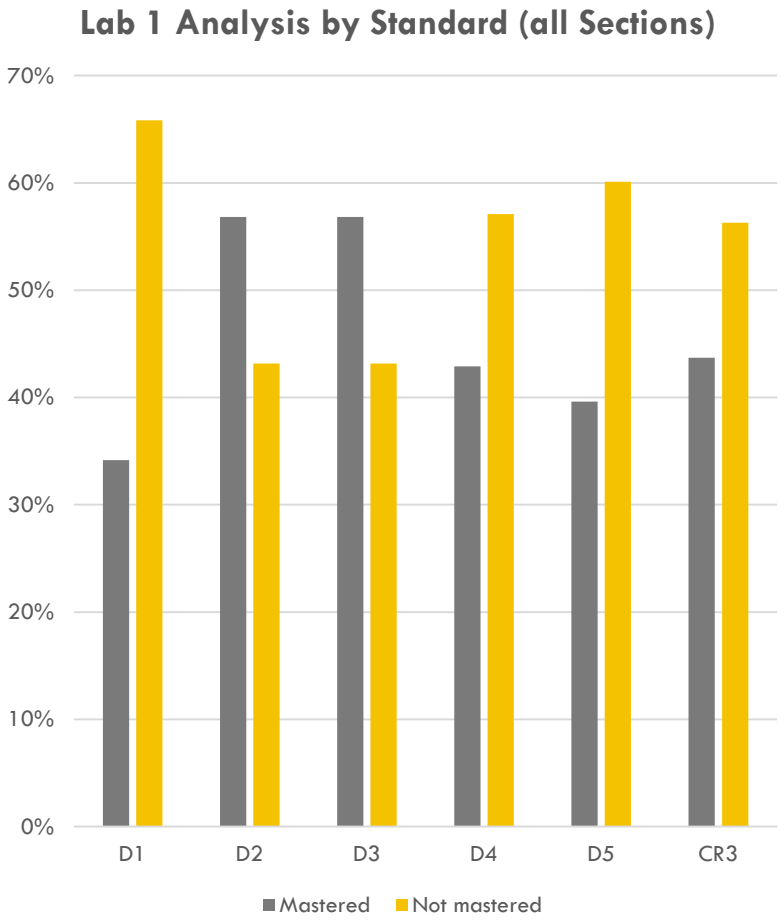
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
	Spring 2019		1090													
	CIN	Name (Please avoid same	D1	D2	D3	D4	D5	CR3	Q1	Q2	Q3	Q4A	Q4B	Q4C	Q5	Q6(ALL)
	0	I	N	E	M	N	N	N	4	1	4	4	3	3	1	2
	0	J	WB	WB	WB	WB	WB	WB	1	1	1	1	1	1	1	1
	0	K	WB	N	N	WB	WB	WB	4	2	2	1	1	1	1	1
	0	L	N	E	E	M	M	N	4	1	4	4	4	4	4	3
	0	M	E	E	M	N	E	E	4	3	3	4	4	4	4	2
	0	N	E	E	E	M	N	WB	4	4	3	4	4	4	3	3
	0	O	N	N	N	WB	WB	WB	4	1	2	4	4	3	2	1
	0	P	WB	WB	WB	WB	WB	WB	1	1	1	1	1	1	1	1
	0	Q	N	N	E	N	WB	WB	4	1	2	4	4	1	1	2
	0	R	M	M	M	E	E	N	4	3	3	4	3	2	4	4
	0	S	M	M	M	N	N	WB	4	2	2	4	4	4	3	2
	0	T	N	N	E	N	N	WB	3	2	2	4	2	1	2	2
	0	U	M	M	N	M	N	WB	4	2	2	4	4	4	4	3
	0	V	N	N	E	N	WB	M	4	3	2	4	2	2	1	2
	0	X	N	N	M	N	WB	N	4	2	1	4	2	4	1	2
	0	Y	WB	M	M	M	N	E	3	1	4	1	1	1	1	3
	0	Z	WB	WB	WB	WB	WB	WB	1	1	1	1	1	1	1	1

		Q1	Q2	Q3	Q4A	Q4B	Q4C	Q5	Q6(ALL)
Question Stats	Average score on question part	3.2	1.72	2.16	2.8	2.28	2.08	1.88	1.88
	Average mastery score	M	N	N	M	N	N	N	N
	% passed (Mor E)	76%	16%	36%	60%	40%	36%	28%	20%
	% not passed (N or WB)	24%	84%	64%	40%	60%	64%	72%	80%

		D1	D2	D3	D4	D5	CR3
Standard Stats	%E	8%	16%	20%	4%	8%	8%
	%M	12%	20%	32%	16%	8%	12%
	%N	40%	40%	24%	44%	36%	20%
	%WB	40%	24%	24%	36%	48%	60%
	%passed	20%	36%	52%	20%	16%	20%
	%not passed	80%	64%	48%	80%	84%	80%

Analysis Results Lab 1(ALL sections)





GE B4 Course Learning Outcomes

- Use mathematical concepts and quantitative reasoning to solve problems, both in a pure mathematical context and in real-world contexts. **(CR3, CR4)**
- Interpret information presented in a mathematical form (e.g. equations, graphs, diagrams, tables, words) and convert relevant information into a mathematical form. **(CR1)**
- Draw appropriate conclusions based on the quantitative analysis of data, recognizing any underlying assumptions or limits of this analysis. **(CR2, CR3)**
- Use deductive reasoning in a pure mathematical context to draw conclusions and provide an irrefutable logical justification for them. **(CR4)**
- Formulate and communicate a position on a real-world question and use appropriate quantitative information in support of that position, and evaluate the soundness of such an argument. **(CR1, CR3, CR4)**

Thank you for listening!



Any questions?

Any experiences you want to share?