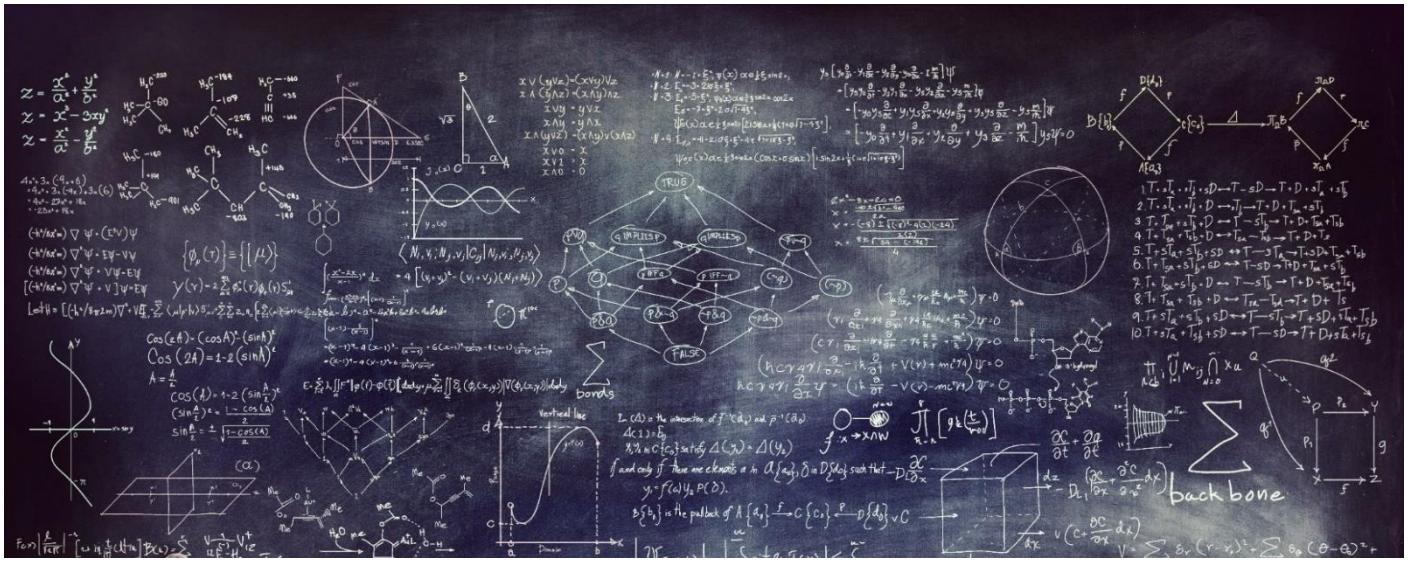

Novel Statistical Analysis in the Context of a Comprehensive Needs Assessment for Secondary STEM Recruitment

Novel Statistical Analysis in the Context of a Comprehensive Needs Assessment for Secondary STEM Recruitment

Students' Success Matters

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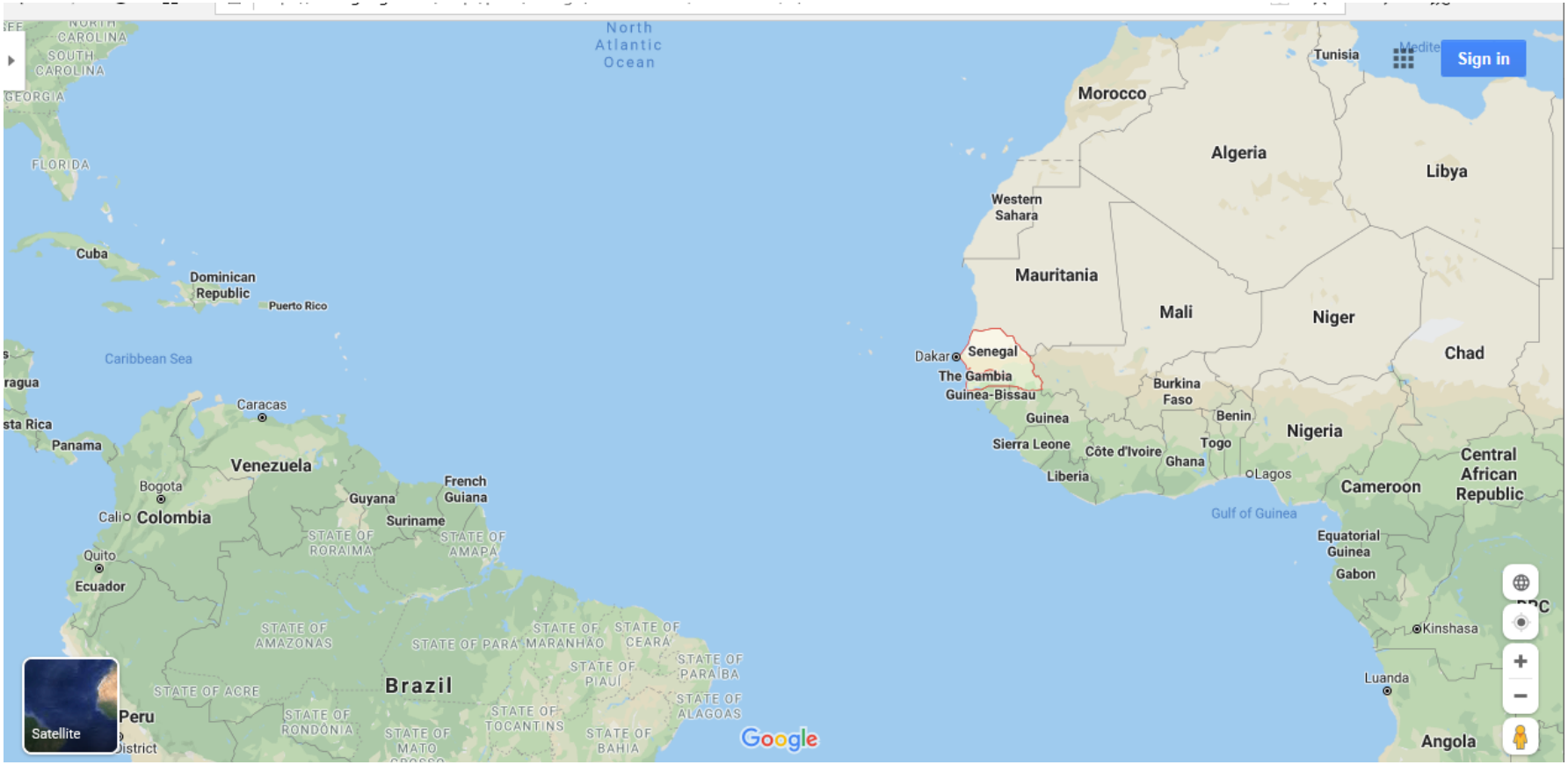
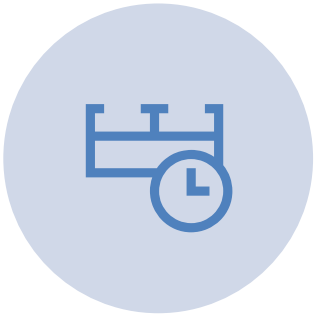

North Atlantic Ocean
Sign in
Tunisia
Morocco
Algeria
Libya
Western Sahara
Mauritania
Mali
Niger
Chad
Dakar
Senegal
The Gambia
Guinea-Bissau
Guinea
Burkina Faso
Benin
Nigeria
Sierra Leone
Côte d'Ivoire
Togo
Ghana
Liberia
Lagos
Central African Republic
Cameroon
Gulf of Guinea
Equatorial Guinea
Gabon
Kinshasa
Luanda
Angola
Cuba
Dominican Republic
Puerto Rico
Caribbean Sea
Caracas
Venezuela
Panama
Bogota
Colombia
Guyana
Suriname
French Guiana
Quito
Ecuador
Peru
Brazil
Satellite
Google

- Studied at University Cheick Anta Diop
- Then Universite du Havre, in France
- Then Auburn University
- Offered position @ Old Dominion University

What is needed to increase recruitment in STEM field?



CRITICAL THINKING

PROFICIENCY IN SOLVING NON-ROUTINE PROBLEMS

TEAMWORK

STEM is needed everywhere…

SHORTAGE OF NURSES, DOCTORS, ENGINEERS, MATHEMATICIANS

STATISTICIANS

DATA SCIENTISTS

STEM JOBS WILL INCREASE

BETTER PAY THAN EVER

- Future
- Environmental
- Health
- Economics
- Behavior
- Accountability
- International Community

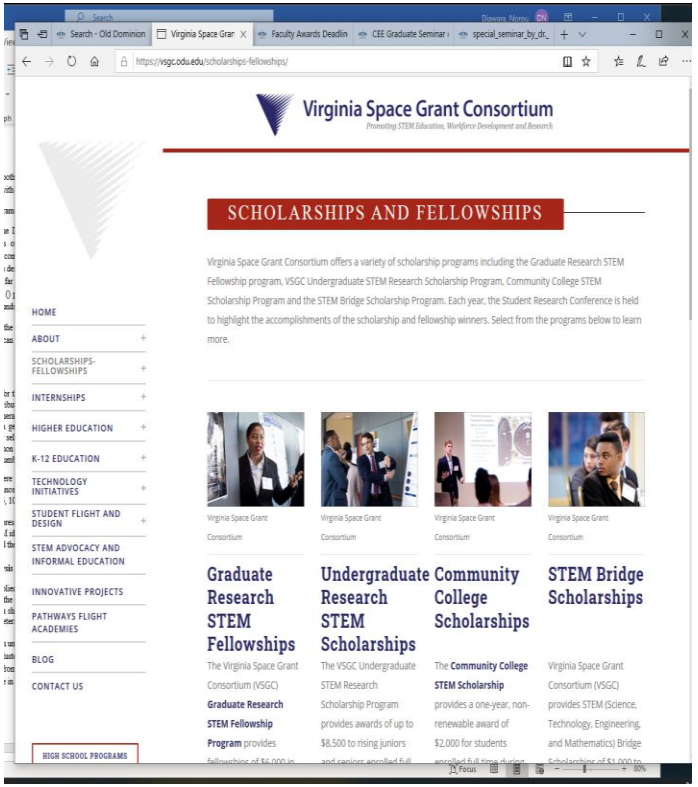
ROBOTS WILL SOON TAKE OVER MANY AUTONOMOUS JOBS

IMPROPER USE OF TECH CAN LEAD TO WAR

Resources?

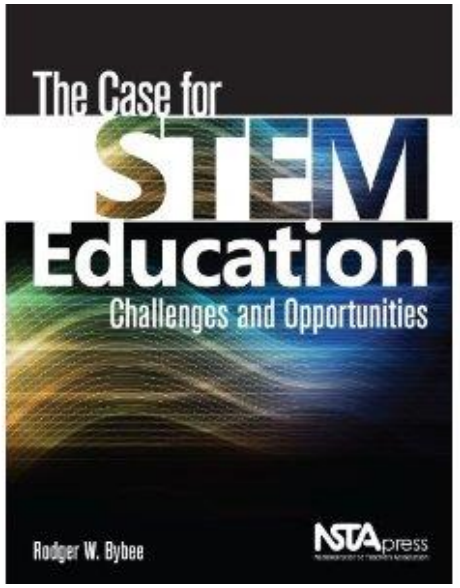
Grants for STEM

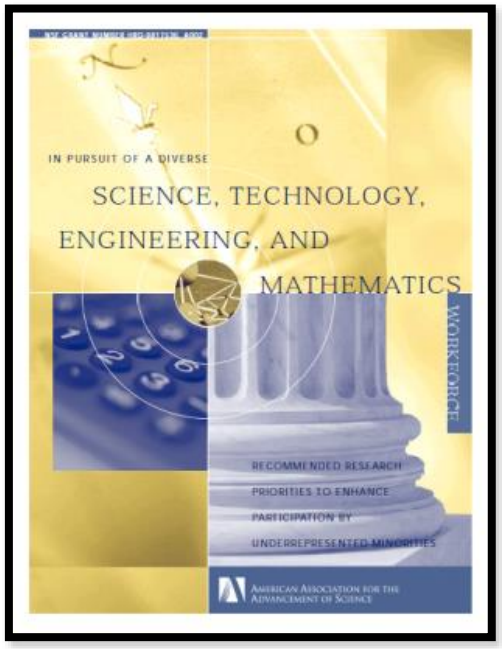
- Advancing Informal STEM Learning (AISL) National Science Foundation. ...
- Science Education Partnership Award (SEPA) National Institutes of Health. ...
- Bay Watershed Education and Training Program (B-WET) ...
- Innovative Technology Experiences for Students and Teachers (ITEST) ...
- Laboratory Equipment Donation Program (LEDP)
- Universities and Colleges



STEM

- Science
- Technology
- Engineering
- Math
- Statistics & Data Science
- Health → STEM-H
- Arts → STEAM





STEM

- **Why the Shortage?**
- **Understand the association of teacher recruitment strategies and STEM interests.**

Survey data and analyze

Hypotheses
Data from built in questionnaire
Algorithms and measure results

Motivation

H1: students generally understand the value of STEM, but do not include Math in STEM. In fact, do they associate Math to STEM?

H2: there are questions involving the liking of Math and its use. The students do have confidence in using STE but do not have confidence in using Math.

The survey was administered at the school level and targeted high schools and both 2-year and 4-year institutions of higher education in the Hampton Road area of Virginia.

Questionnaire

Q6: I like using science
Q8: I plan to use science in my future career.
Q12: Generally speaking, I like doing Math.
Q14: I plan to use Math in my future career.
Q15: If I do well in Math classes, it will help me in my future career.
Q19: Generally speaking, I like activities involving technology.
Q26: Generally speaking, I like activities involving engineering.

Exploratory Factor Analysis (EFA)

Generalized Linear Analysis (GLM)

Quantile Analysis (QA)

Exploratory Factor Analysis (EFA)

Q2	Frequency	Percent	Cumulative	Cumulative
Gender			Frequency	Percent
Female	208	66.88	208	66.88
Male	103	33.12	311	100
	Frequency Missing = 2			

Q4	Frequency	Percent	Cumulative	Cumulative
Schooling methods			Frequency	Percent
Community college	65	20.97	65	20.97
High School	47	15.16	112	36.13
Public university	198	63.87	310	100
Frequency Missing = 3				

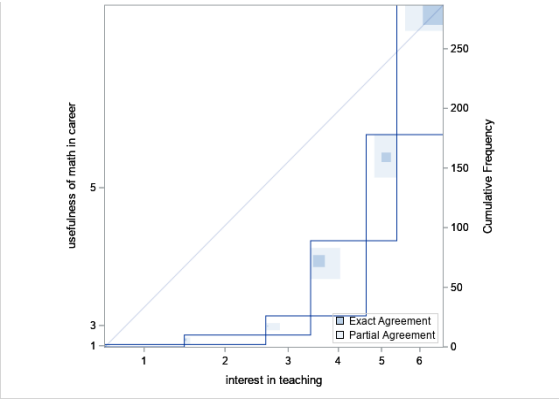
Q3	Frequency	Percent	Cumulative	Cumulative
Race			Frequency	Percent
Black	100	31.95	100	31.95
Other	59	18.85	159	50.8
White	154	49.2	313	100

Variable	Strongly Disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly Agree
Q-6 Like science	0	2.56	4.79	18.21	33.87	40.58
Q 8 Use of science	1.92	4.79	3.19	17.89	25.56	46.65
Q 12 Liking Math	11.84	7.57	9.21	25	28.29	18.09
Q 14 use of Math in the future	4.28	5.26	8.22	22.37	29.28	30.59
Q 15 Perception of Math in Science	0.34	3.03	5.39	21.55	31.65	38.05
Q 19 Like Technology	0.68	2.74	5.48	24.66	33.22	33.22
Q 26 Liking Engineering	6.64	18.18	15.38	25.87	18.18	15.73

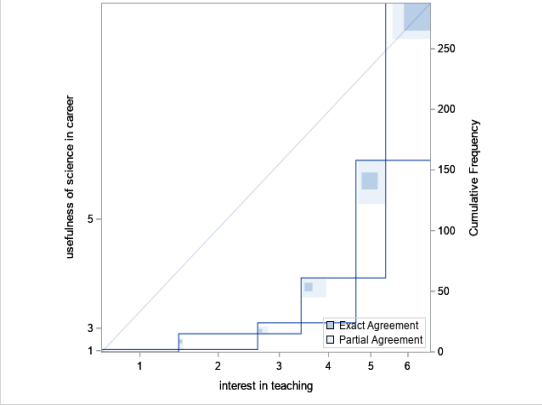
EFA

Fifty-seven percent of respondents agreed or strongly agreed to the question "**I believe that teaching is a valued profession in our country,**" but **only 21 percent** of respondents strongly agreed or agreed to "**I can see myself as a middle or high school STEM teacher in the future**."

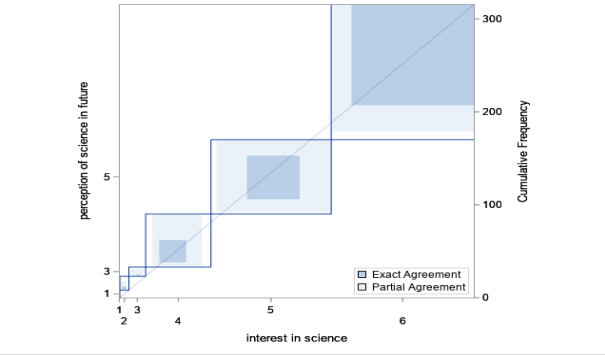
Agreement plot of **mathematics usefulness** in career and interest in teaching.



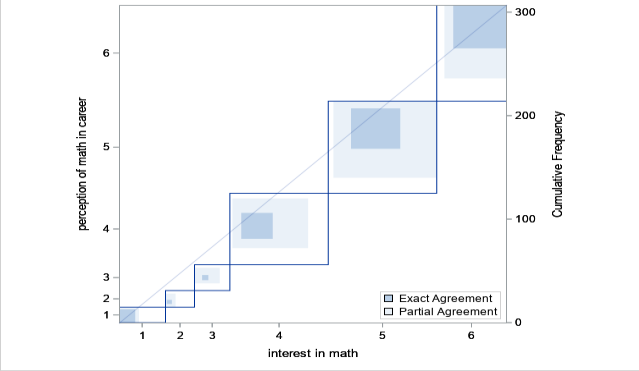
Agreement **between science usefulness in career and interest in teaching**.



Agreement plot of **interest in science and perceived usefulness of science in future career**.



Agreement plot between **interest in mathematics and perceived usefulness of mathematics in future career**.



EFA

Score1= Likes Science (Q6)+Likes Math (Q12)+Likes Tech (Q19)+Likes Eng. (Q26), that describes liking of STEM.
Score2= Q7_new+Q13_new+Q20_new+Q27_new, that describes understanding of STEM.
Score3= Q8_new+Q14_new+Q21_new+Q28_new, that describes career of STEM.
Score4= Q8_new+ Q21_new+Q28_new, that describes using of **STE**.

Focused investigation about why students' responses about Math and their perceptions of the usefulness of Math varied so starkly when compared to the other STEM disciplines

H1: students generally understand the value of STEM, but do not include Math in STEM. In fact, do they associate Math to STEM?
H2: There are questions involving the liking of Math and its use. So, the second aspect is the hypothesis that in their training, students do have confidence in using STE but do not have confidence in using Math. The students do not even seem to acknowledge the Math influence in STEM careers. Math is in its own bubble. They do not connect Math with STEM.

Pearson Correlation Coefficients				
Prob > |r| under H0: Rho=0				
Number of Observations				
	score1	score2	score3	score4
score1	1	0.82325	0.80592	0.75282
		<.0001	<.0001	<.0001
	288	287	285	285
score2	0.82325	1	0.7713	0.71268
	<.0001		<.0001	<.0001
	287	288	285	285
score3	0.80592	0.7713	1	0.93853
	<.0001	<.0001		<.0001
	285	285	286	286
score4	0.75282	0.71268	0.93853	1
	<.0001	<.0001	<.0001	
	285	285	286	286

Generalized Linear Analysis (GLM)

Analysis

The Score 3 values show that gender difference (male and female only) could be removed from the model statement, as the marginal lines based on gender cross, although the lines are positive with the liking of engineering, with then $\hat{\sigma}^2 = 6.25$. In later models, we include additional predictors and attempt to account for some of the variability in Score 3.

The analysis shows that the likings of science, Math and technology are highly significant in predicting Score 4. However, when the liking of engineering and race are added in the model, the liking of Math and gender become non-significant in predicting Score 4. This shows that "doing Math" is not so well acknowledged in Score 4 in the use of STEM. This confirms the second hypothesis. In other words, the second hypothesis is not rejected.

Also, the correlation between Score 3 and Score 4 is quite strong and is not ignorable. That explains similar results with all the variables, except for the liking of Math. In Score 4, the liking of Math is not significant. There is a strong correlation between liking of STEM and use of STE.

We interpret the gender as micro-unit naturally occurring when the unit groups (Q6, Q12, Q19 and Q26) are not revealed/included.

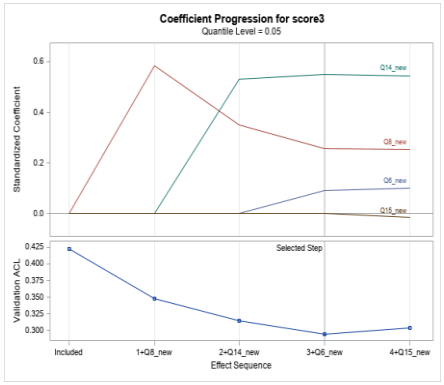
The achievements in Score 3 and Score 4 are differentiated by the liking of Math.

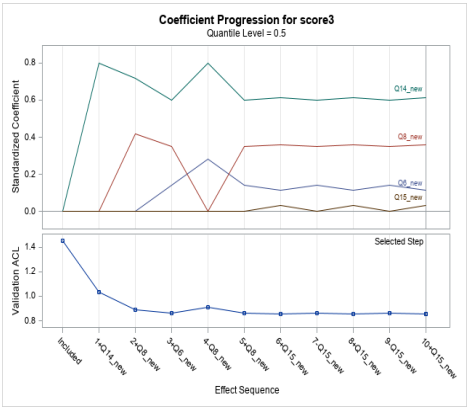
Assumptions of independence and normality of responses and homogeneity of variances are not sustained.

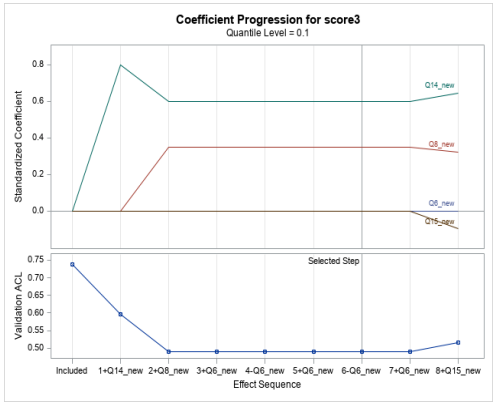
The KMO- measure of sampling adequacy turned out to be 0.781, indicating that the data is suitable to perform quantile factor analysis (Cerny & Kaiser, 1977; Xuexia, 2011).

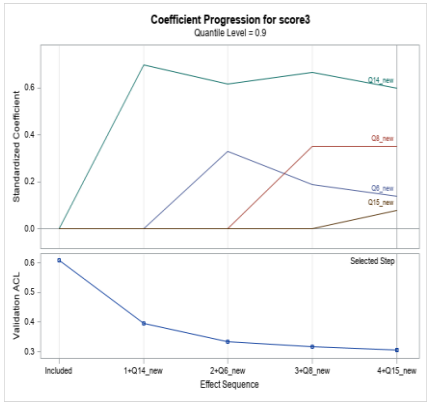
Quantile Analysis (QA)

The quantile regression with least absolute shrinkage and selection operator procedure will compare and differentiate the students with higher Score 3 vs those with lower Score 3, by considering the sparse model at 0.05, 0.1, 0.5, and 0.9 quantiles. 30% of the data was reserved as validation, which avoid overfitting. The output for the quantiles at 0.10, 0.50 and 0.90 are presented in Figure 3. One interesting characteristic is that the AIC has a negative parabola shape. The values of the AIC increase from 0.05 to 0.5 quantiles and then decrease from 0.5 to 0.9 quantiles. This shows that the career in STEM is mostly of better fit at the high and low quantiles of the students that are surveyed.









Q14: use of Math in the future
Q8: use of Science
Q6: like Science
Q15: Perception of Math in Science

Conclusion

So, both hypotheses are sustained.

Students generally understand the value of STEM but ignore the Math component of STEM.

They also like and have confidence in using STE (mostly female) but lack confidence in using Math.

The results are full of insights as it will help suggest guidance and training bridges. Indeed, education is a service field, a must/need for any sustainable development, with great rewards. So those that are leading the training should have acquaintance that the concepts our students have about Math can be described as a function of the understanding that Math components play in the curriculum. Connecting the training with the issues will help students gain confidence in their abilities to become STEM teachers and influence students in the Math areas.

H1: students generally understand the value of STEM, but do not include Math in STEM. In fact, do they associate Math to STEM?
H2: there are questions involving the liking of Math and its use. So, the second aspect is the hypothesis that in their training, students do have confidence in using STE but do not have confidence in using Math. The students do not even seem to acknowledge the Math influence in STEM careers. Math is in its own bubble. They do not connect Math with STEM.

Science really rocks.
Data Science and Statistics will be present in almost all research efforts

Thank you

We gratefully acknowledge the research team at ODU and collaborators as well as the many scientists who are part of the education programs in the Southeast. Funding was provided by NSF's NOYCE Capacity Building Grant award number 1852813.

Thank SDSS

Questions?
Comments?
Thoughts?