Making the Case for Grant Funding: Using Social Justice to Practice Creating and Analyzing Regression for Secondary Mathematics

By Melissa Hinchman, 2020 CTI Fellow
West Charlotte High School

This curriculum unit is recommended for:
NC Math II or NC Math III

Keywords: NC Math II, NC Math III, Regression, Line of Best Fit, Social Justice, Youth-led Participatory Action Research, Statistics

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit.

Synopsis: NC Math II or NC Math III students will learn how to create a regression equation, describe the key features of the created function, and analyze regression based off the contexts of their data to explain the history of the data, the current trends, and to make predictions. While students are learning math, students will be engaged in social justice research, reflection, and personal connection with the intent to empower students to feel seen within the curriculum, grow in race-related identity, and have a solution-orientated mindset. This unit should help teachers have viable curriculum that is relevant, anti-racist, and student-centered application of course standards.

I plan to teach this unit during the coming year to 50 students in MYP Honors NC Math 2.

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Melissa Hinchman

Introduction

Numbers represent a value and they tell a story. The value 4.4% has been a continuous conversation in Charlotte, NC since 2014 when a Harvard study (cite) found that Charlotte, NC has one of the lowest probabilities of upward income mobility for children in the nation. Our children have a 4.4% chance of reaching the top fifth of income distribution. The study found five factors strongly correlated with the variation in upward mobility. Of those five, two connect to our school system: neighborhood racial and income segregation and proximity to a quality K-12 school system. Furthermore, the study found that upward income mobility is the lowest in areas with the largest Black population.[i] As a teacher at West Charlotte High School, this study is personal. West Charlotte is a Title 1 high school in the Central 1 Learning Community off of Beatties Ford Road on the West Side; a historical Black community in Charlotte, NC. We were once a national model for successful racial integration during the Civil Right Movement, but we fell from that standard following Swann v. Charlotte-Mecklenburg Board of Education in 1971 that ended busing used to desegregate schools.[ii]

Today our student body reflects one of resegregation both racially and socioeconomically. 98% of our student population qualify for free or reduced lunch signaling an overwhelming proportion of our families face economically disadvantages. Racially, 80.3% of our 1,456 students are African-American, 13.0% are Hispanic, 2.7% are Asian, and 1.5% are White.[iii] This does not reflect the racial proportions of our city. Not only does West Charlotte face segregation racially and economically, disadvantages are reflected in academic performance. During the 2018-2019 school year, 16.1% of incoming freshman at West Charlotte are academically proficient compared to 40.9% of incoming freshman across the state of North Carolina. In addition, only 8.8% of students reached 'College and Career Ready" (CCR) score on the NC Math III End-of-Course (EOC) exam and 26.8% reached "Grade Level Proficient" (GLP), which means 64.4% scored below grade level. The literacy data is also underwhelming. On the NC English II EOC, 20.6% of students reached the CCR range and 28.4% were considered GLP.[iv] In other words, that Harvard study I mentioned earlier is talking specifically about my students.

In an effort to change the narrative, West Charlotte High School is partnered with Equal Opportunity Schools (EOS) to address equity issues pertaining to access to rigorous course work such as Advanced Placement (AP) and International Baccalaureate (IB) classes. Traditionally, standardized test scores and grade point averages (GPA) have been used to qualify a student to take AP or IB courses. According to research conducted by EOC, those unit of measure are not the best predictors of a student's ability to succeed in AP and IB courses.

In order to prepare underclassmen for AP and IB course work, West Charlotte is in the process of being certified for Middle Years Program (MYP), which includes curriculum that is inquiry and

application based. This project will be able to be imbedded with MYP assessment criteria and grading rubrics.

With this information in mind, this project is designed to reach three main goals. First, to teach students how to create a regression equation that best fits a set of data, and to be able to analyze that data for meaning using an understanding of function key features and historical context. In other words, I will teach my students to use an essential math skill and apply it to a social justice topic relevant to their times, including racial justice topics. Using regression analysis, students will be able to identify inequities between groups relevant to the self-selected topic they have chosen. Being able to analyze data themselves means that students can push themselves and others to evaluate the validity of previously held beliefs to make sure those beliefs are supported by research. Regression is foundational to the study of data science, which is a field that is overlooked by the North Carolina math and science curriculum, because the topic is not highly tested on NC End of the Course Exams or on NC Final Exams. IBM predicts that job openings in data science will increase by 364,000 to 2,720,000 openings nationwide by 2020.[v] Having an interest in a growing field would help to address upward income mobility in Charlotte, NC. Second, this unit will empower students to be solution orientated. Our students face heavy stressors and burdens in the world that their generation did not create. To navigate this, students must be able to defend, persuade, and believe that a social justice issue can be disrupted. Last and most importantly, this project aims for students to see their identities as valuable parts of a solution, making curriculum relevant and affirming that our students' perspective matters in the world. Adolescent ethnic identity development develops over years and years of racial encounters. Those encounters allow a student the chance to explore, examine, and create a positive internalized understanding of their own racial or ethnic identity.[vi] This project is designed to be one of those pivotal encounters.

Instructional Content

This curriculum project is written during a period of time when it feels like the world is on fire. 2020 has carried with it blow after blow after blow. We started the year with Australia literally on fire, President Trump being impeached, national protests following the killing of Ahmaud Arbery, George Floyd, and Breonna Taylor, the back to back disappointments when police officers are not held accountable for biased actions and a global pandemic that has killed over 297,000 people in the United States. More than ever teachers need to be providing high quality content that can be taught in-person or remotely and that put students in control.

What teachers view as high quality curriculum has long been debated, but most can agree that curriculum should be rigorous enough to grow a student's abilities and perspectives, while being relevant to a student's life. What is not discussed is the racism and inequities that plague traditional school curriculum. Part of the struggle is that students and adults do not know how to navigate productive conversations about race and identity. Often, we get trapped in a false good and bad dichotomy with racism. A good person cannot be racist and only bad people are racist. As soon as something is identified as racist, people, most often white people, become defensive.[vii] This emotion is understandable, but misplaced. As white people raised in a white racial framework, we are inherently racist. So then, are we all bad? No, if we are able to

transition to an antiracist frame of mind. We must be actively working to fight racism not only through our own actions and thoughts, but more importantly by fighting for structural changes. Antiracism is rooted in an ongoing confrontation with the philosophy of racism, structures of racism built in American way of life. This confrontation must be collective and grounded in listening to the lived experiences of Black antiracists.[viii] How do we build this collective action? We educate our children. In *Antiracism: An Introduction*, Alex Zamalin states,"…education matters because it enables citizens to do what racists say is impossible: the make autonomous decisions, resist strenuous circumstances, and cultivate self-worth."[ix] I would challenge that a teacher that does not want these ideal for their students should not be in the profession.

If teachers and students are maximizing the opportunities within this project, there should be times of uncomfortable conversation, questions that do not have clear answers, and an establishment of a trusting relationship between student peers and between the teacher and students. The beauty of antiracism is that everybody grows.

The core of this project is modelled by the structure and work of Youth-led Participatory Action Research (YPAR), which started as a partnership through the University of California, Berkeley and San Francisco Peer Resources. The YPAR Hub has grown to include online curriculum for nonprofit purposes at K-12 schools, colleges, or universities.[x]

Pre-Work

There are three main stages to this project: Picking a Topic, Research, and Proposal. Each stage needs to be intentionally weaved throughout the course with the proposal as a summary artifact for the whole course. Below is the prompt for students:

> You are the Executive Director of a nonprofit organization that you started. You are working to secure a grant that would help pay for programs that your organization is hosting and your employees. Your goal is to persuade the grant committee that the mission of your organization is addressing a critical social justice issue in your community and is factually based, while providing insight as to the history, the current status, and the possible future of your issue if your organization is not provided the grant money. To do this you must provide raw data, approximate an equation that represents the data set using a regression that is to be visually represented. The grant committee would also like to know that a diverse group of people are passionate about the mission of your nonprofit. You will need to provide evidence of at least one person, who has been overlooked for their contribution due to their racial, ethnic, sexual, or class identity.

> You will need a presentation to share with the grant committee. Include all mathematical calculations, justifications, and reasoning, as expected by the grant committee for approval. Use the outline below for structure.

> **Non-Profit:**
> - What is your mission?
> - What social justice problem are you working to disrupt?

- Why does this topic matter to you and to your community?

Data Set:
- What is the source for your data set? Can you justify the validity of your source?
- How does your data set connect to the mission of your nonprofit?
- What is your data set? What is being measured? What is your independent and dependent variable?

Regression:
- What type of regression was used?
- Why was that regression the most appropriate for the data set?
- What equation was created by the regression?
- Include a visual representation of your data set and your regression model

Relevance:
- Using key features to describe your regression, describe the history of your issue.
- Using key features to describe your regression, describe the current trends of your issue.
- Using key features to describe your regression, describe the possible future of your issue if the current trends continue.
- How does the person you researched contribute to the relevance of the work and how does their perspective influence your social justice topic?

Using the framework provided by YPAR, teachers will start this project by building relationships between teacher and students and within the students themselves.[xi] This is already a fundamental element to teaching that starts the moment you meet your students and never completely ends. Before the school year starts, teachers need to reflect on how they build relationships and if their classroom culture is one where all students feel comfortable. Robin Diangelo offers a list of common guidelines that are actually problematic for building trust:[xii]

- Don't judge – When talking about social justice issues it is not possible to not judge, which means you have set your students up for failure.
- Don't make assumptions – In a similar way to judgements, this is not possible to no do. There is also no way you as the teacher nor your students could be held accountable.
- Assume good intentions – This prioritizes intention over impact, which centers the person who said a problematic statement, and affirms their actions using good intentions as their loophole.
- Speak your truth – This implies that students would otherwise lie about their perspectives and experience in the world. Furthermore, this implies that all truths are equally valid, which is not the case. Not all beliefs or opinions are factually based.
- Respect – What is respect? It has an ambiguous answer, because showing respect is culturally based. Often what is seen as respectful is only defined through the eyes of the teacher, yet not all teachers represent the cultures of their students.

A word on pacing. Charlotte Mecklenburg Schools suggested pacing is that teachers cover regression and key features each time a new function is introduced, which means that these topics get repeated for quadratics, square root, and rational functions. This project is meant to either summarize or meant to teach regression and key features of functions at one time. You will need to make a decision that is best for your students. At West Charlotte, I feel that students consistently struggle with key features, but are quick to understand regression. I choose to repeat the instruction of key features each time a new function is taught, but I want to teach regression until after I have introduced all new functions. This is when I also increase the rigor of key features by asking students to make comparisons and apply key features to the context of a problem. By the time I get to regression, I have allowed the maximum amount of time to build students' confidence of identifying key features from multiple representations. The inspiration for this staggered approach is from PEAK Learning Systems.[xiii]

Part 1: Topic

During the first few weeks of the course, you will need to develop your students' awareness of community issues. You will need to get creative as to how to be able to continue teaching other content while developing students' awareness. Some techniques that have worked in the past are:

- Include a reflection during Warm Up time and allow for student discussion.
- Create a digital discussion board such as a Padlet.com or the Discussion feature on Canvas.
- If in person, provide students with topic information overnight and have a specific notebook for students to record their thoughts. Write back to students to provide feedback and commentary.

Teachers need to help students tie those community problems to social, historical, economic, and/or environmental reasons that go beyond the community and are systematic issues related to stereotypes, oppression, and/or discrimination.[xiv] Depending on your own racial or ethnic identity and that of your students, this process could take several months. Below are a list of topics that could be discussed with students to increase their awareness, but no forget to ask your students. See Appendix 2 for links to some resources.

- Mass incarceration in America
- Police Brutality
- Representation
- Ableism
- Income Inequality
- Wealth Inequality
- Food Deserts
- Implicit Bias
- Clean Water

Once you feel that you students are ready, students will identify a social issue in their community and explain at least two root causes for this issue. This will become the foundational to a student's nonprofit organization. Bringing in guest speakers from existing nonprofits in the community or have students explore these organization's websites to see examples of mission statements would be a great way to decenter the teacher as the only source of knowledge. Students will get anonymous approval and feedback from at least two peers before you approve the topic. This action will allow students to be centered as a source of knowledge in your room.

Part 2: Research

Next students will be finding raw two variable data related to at least one of the root causes. Using the raw data, teach students how to identify the best function (linear, quadratic, exponential, square root, or rational) that would create a line of best fit to model the data. Traditionally, this is done with a physical graphing calculator, but due to remote learning, many schools have switching to teaching this skill using Desmos.com. [Appendix 2](#) for links to some resources.

Students will need to analyze the graph using key features to explain the history behind this data, what is currently happening based off this data, and to make predictions about the future of their social justice topic if the trends found in the regression equation continue. You will need to guide students through this process and encourage them to ask why the data is what it is. Students will need to look at the history of their topic to find any possible justifications. For example, a student doing research on wealth inequality might see a large interval of decrease around 2007 to 2009. That student needs to make the connection that during that time America was experiencing an economic recession. This is an opportunity for you to take students on a field trip to a history museum or to collaborate with your social studies department so that students can make the connection between equation trends and history.

In addition, students will find at least one person that is already involved in the social justice topic that inspire or give a student purpose to work on this issue. The goal would be for students to find people that are Black, Brown, or Indigenous and might have been or are currently overlooked despite having greatly contributed to work being done within the student's social justice topic. Given the demographics of West Charlotte High School, I want to ensure that my project dedicates space for my students to see people, who look like them, in a positive, affirming, and valued role in our community. The goal is for students to be able to see what is currently happening with their topic at the local level. This is an opportunity for students to conduct an interview or to work closely with a up and running nonprofit organization.

Part 3: Proposal

The last component is for students to put together their presentation. This presentation includes all components of the project and is presented to the class, who is the grant committee. This is also an opportunity for community members to visit classrooms or Zoom class sessions and participate in the presentation process. A student will receive anonymous feedback from at least two of their peers, any community members, and the teacher. The student will also take time to provide their own reflection about their work. At West Charlotte High School we have an IB

MYP Assessment Task Form that is commonly used. This form is located below. For a digital copy, see Appendix 2.

IB MYP Assessment Task

Student Name:

Assignment:

Subject: Teacher:

Total Criteria Score: CMS Score: out of

Criterion	Score (1 – 8)	Comments
A		
B		
C		
D		

Student –Self- Assessment

This is what I understood about the assignment	
I misunderstood	
I still do not understand	
Now I to learn	

Assessment

This project will be assessed using IB MYP standards and rubrics. Even if you are not an IB school, you can still incorporate concepts of IB to enrich learning for all students.[xv]

My priorities for this project centered to the criteria below.

Criterion C: Communicating - Students use appropriate mathematical language and different forms of representation when communicating mathematical ideas, reasoning and findings, both orally and in writing.

Criterion C: Communicating

Maximum: 8

At the end of year 5, students should be able to:

i.   use appropriate mathematical language (notation, symbols and terminology) in both oral and written explanations

ii.   use appropriate forms of mathematical representation to present information

iii.   move between different forms of mathematical representation

iv.   communicate complete, coherent and concise mathematical lines of reasoning

v.   organize information using a logical structure.

Achievement level	Level descriptor
0	The student **does not** reach a standard described by any of the descriptors below.
1–2	The student is able to: i. use **limited** mathematical language ii. use **limited forms** of mathematical representation to present information iii. communicate through lines of reasoning that are **difficult to interpret**.
3–4	The student is able to: i. use **some appropriate** mathematical language ii. use **appropriate forms** of mathematical representation to present information **adequately** iii. communicate through lines of reasoning that are **complete** iv. **adequately organize** information using a logical structure.
5–6	The student is able to: i. **usually** use **appropriate** mathematical language ii. **usually** use **appropriate forms** of mathematical representation to present information **correctly** iii. **usually** move between different forms of mathematical representation iv. communicate through lines of reasoning that are **complete and coherent** v. **present** work that is **usually organized** using a logical structure.
7–8	The student is able to: i. **consistently** use **appropriate** mathematical language ii. use **appropriate forms** of mathematical representation to **consistently** present information **correctly** iii. move **effectively** between different forms of mathematical representation iv. communicate through lines of reasoning that are **complete, coherent and concise** v. **present** work that is **consistently organized** using a logical structure.

Criterion D: Applying Mathematics in Real-Life Contexts - Students transfer theoretical mathematical knowledge into real-world situations and apply appropriate problem-solving strategies, draw valid conclusions and reflect upon their results.

Criterion D: Applying mathematics in real-life contexts

Maximum: 8

At the end of year 5, students should be able to:

i.   identify relevant elements of authentic real-life situations

ii.   select appropriate mathematical strategies when solving authentic real-life situations

iii. apply the selected mathematical strategies successfully to reach a solution

iv.   justify the degree of accuracy of a solution

v.   justify whether a solution makes sense in the context of the authentic real-life situation.

Achievement level	Level descriptor
0	The student **does not** reach a standard described by any of the descriptors below.
1–2	The student is able to: i. identify **some** of the elements of the authentic real-life situation ii. apply mathematical strategies to **find a solution** to the authentic real-life situation, **with limited success**.
3–4	The student is able to: i. identify the **relevant** elements of the authentic real-life situation ii. select, **with some success**, **adequate** mathematical strategies to model the authentic real-life situation iii. apply mathematical strategies to **reach a solution** to the authentic real-life situation iv. **discuss** whether the solution makes sense in the context of the authentic real-life situation.
5–6	The student is able to: i. identify the **relevant** elements of the authentic real-life situation ii. select **adequate** mathematical strategies to model the authentic real-life situation iii. apply the selected mathematical strategies to **reach a valid solution** to the authentic real-life situation iv. **explain** the degree of accuracy of the solution v. **explain** whether the solution makes sense in the context of the authentic real-life situation.
7–8	The student is able to: i. identify the **relevant** elements of the authentic real-life situation ii. select **appropriate** mathematical strategies to model the authentic real-life situation iii. apply the selected mathematical strategies to **reach a correct solution** to the authentic real-life situation iv. **justify** the degree of accuracy of the solution v. **justify** whether the solution makes sense in the context of the authentic real-life situation.

Teacher Strategies

West Charlotte High School uses best practices for instruction, classroom management, and coaching set by a program called Success by Design. This program instructs teachers to begin planning instruction with the final assessment, which should be aligned to NC State Standards, and work backwards to develop a plan for the curriculum unit by unit. The thought is that the final assessment would then be used to develop unit assessments, unit assessments would be used to create lessons, so that students are prepared to show mastery on all course assessments. This same process should be applied when implementing this and other project-based learning.

Mathematical instruction is commonly lecture based with the support of guided notes, a collaborative activity, and then independent practice. While teaching current skills, old skills are re-looped to help students develop long-term memory and pre-requisite skills that are needed for future new skills are sprinkled into elements like warm ups and homework. Even though all of these strategies are in place, the switch to remove instruction due to the covid-19 pandemic has changed how students and teachers are engaging with one another. Charlotte Mecklenburg Schools has required that all learning must be able to be completed asynchronously to allow flexibility and grace to students and their families. West Charlotte math teachers have moved towards a flipped classroom model in which teachers prerecord instruction for kids to listen and take notes on at home the day before class. The class time is then used to clarify misconceptions, have discussions with classmates, complete guided practice problems, and for small group intervention. As much as teachers have been able to adapt to keep students learning during this time, is no way for us to get back the 17% instructional time that was cut in efforts to limit time on Zoom. This project can be adapted to fit within covid-19 restrictions with the use of discussion boards to collaborate, teaching students how to record presentations, and using digital forms to collect data and feedback.

Appendix 1: North Carolina Teaching Standards[xvi]:

NC.M2.F-IF.7 Interpreting Functions - Analyze functions using different representations. Analyze quadratic, square root, and inverse variation functions by generating different representations, by hand in simple cases and using technology for more complicated cases, to show key features, including: domain and range; intercepts; intervals where the function is increasing, decreasing, positive, or negative; rate of change; maximums and minimums; symmetries; and end behavior.

SWBAT use either a TI Calculator or Desmos.com to create a regression equation from a set of data points.

SWBAT determine which type of regression equation will create the best fit to model the data points.

SWBAT identify the domain and range, x and y intercepts, intervals of increase, decrease, positive, or negative, find the rate of change for a given interval, maximums, minimums, lines of symmetries, and end behavior of a graphed regression equation.

NC.M2.F-IF.9 Interpreting Functions - Analyze functions using different representations.
Compare key features of two functions (linear, quadratic, square root, or inverse variation functions) each with a different representation (symbolically, graphically, numerically in tables, or by verbal descriptions).

SWBAT compare different key features of their graphed regression equation to notice any relevant similarities and differences.

NC.M2.F-IF.4 Interpreting Functions – Interpret functions that arise in applications in terms of the context.
Interpret key features of graphs, tables, and verbal descriptions in context to describe functions that arise in applications relating two quantities, including: domain and range, rate of change, symmetries, and end behavior.

SWBAT relate and interpret key features to the context of their social justice project.

Appendix 2: Resources

Teacher Resources

Racial Equity Tools
https://www.racialequitytools.org/home

Amplify
https://amplify.com/
- Math Teacher Lounge: https://amplify.com/math-teacher-lounge

Teaching Tolerance
https://www.tolerance.org/

Instructions on how to create a regression equation using a TI Calculator.
https://studenthelp.cpm.org/m/TI-84/l/95288-ti-84-non-linear-regressions

Instructions on how to create a regression equation using Desmos.com.
https://support.desmos.com/hc/en-us/articles/202532159-Regressions
https://thegeometryteacher.files.wordpress.com/2014/07/11-tutorial-regression-on-desmos.pdf

West Charlotte High School's IB MYP Assessment Task Form
https://docs.google.com/document/d/1N8mPD9_NEbh-xdJPMau4T32eRs__o-7PxAhA-rUUTD4/copy

Student Resources

United States Government – Datasets from various publishers, bureaus, and topics
https://catalog.data.gov/dataset

United States Census Bureau
https://www.census.gov/data.html

Pew Research Center
https://www.pewresearch.org/internet/datasets/

Berkeley Library - Health Statistics & Data: Datasets/Raw Data
Lists of national Datasets and California Datasets pertaining to health topics.
https://guides.lib.berkeley.edu/publichealth/healthstatistics/rawdata

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[ii] Grundy, Pamela. *Color and Character: West Charlotte High School and the Struggle for Educational Equity in America.* pp 120-123.

[iii] Charlotte-Mecklenburg Schools. "West Charlotte High School Profile Overview"

[iv] Ibid.

[v] Burning Glass Technologies, Business-Higher Education Forum, and IBM. "The Quant Crunch: How the Demand for Data Science Skills is Disrupting the Job Market."

[vi] Tatum, Beverly Daniel. *Why Are All the Black Kids Sitting Together in the Cafeteria? And Other Conversations About Race.* pp 236.

[vii] Diangelo, Robin. *White Fragility: Why it's so Hard for White People to Talk About Racism.* pp 71-81.

[viii] Zamalin, Alex. Antiracism: An Introduction. pp. 51-57.

[ix] Zamalin, Alex. Antiracism: An Introduction. pp. 65-66.

[x] YPAR Hub. "YPAR Hub - Online Curriculum"

[xi] Youth Activism Project. "What is Youth Participatory Action Research?"

[xii] Diangelo, Robin. *White Fragility: Why it's so Hard for White People to Talk About Racism.* pp 126-127.

[xiii] Rogers, Spence. *Teaching for Excellence: Essential Concepts, Strategies, Techniques, and Processes for Ensuring Performance Excellence for All Kids*.

[xiv] Youth Activism Project, "What is Youth Participatory Action Research?"

[xv] International Baccalaureate. *Mathematics Guide.* pp. 33-48.

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