Mathematics 12 RESEARCH Project (MRP)

**Outcome**

**MRP01** Students will be expected to research and give a presentation on a topic that involves the application of mathematics.

**Performance Indicators**

MRP01.01 Collect primary or secondary data (statistical or informational) related to the topic.

MRP01.02 Assess the accuracy, reliability, and relevance of the primary or secondary data.

MRP01.03 Make a statement and justify the statement based on your data.

MRP01.04 Identify controversial issues, if any, and present multiple sides of the issues with supporting data.

MRP01.05 Organize and present the research project using technology.

**Things to keep in mind:**

1. This project is to be done alone.
2. It is to be created in Google slides and then shared with Mr. Phelps ( [dphelps@gnspes.ca](mailto:dphelps@gnspes.ca) ).
3. You must present your project during class – 5 to 10 min.
4. You need to collect data – through gathering data first hand or through research.
5. The same topic cannot be covered by more than one student.
6. **The deadline to pick your topic is Friday, November 4th**. The sooner you pick your topic the less likely it will be taken by someone else.
7. **The deadline to submit your Google Slide Presentation is Monday December 12. The presentation date is Thursday December 15th.** There will be NO extentions to these dates.

**Some questions to consider while thinking about which topic to pick:**

* Does the topic interest you?
* Is there an important issue related to the topic?
* Are you confident you can find suitable sources and sufficient data for the topic?
* Will this topic allow you to demonstrate your mathematical understanding? This is critical because the most important part of the project is demonstrating your understanding of the mathematics along with interpretation and reasoning.

**References**

You will require either extensive research or data gathering to do a proper job so maintaining a careful record of your sources is critical. A proper list of works cited is a necessary component of a completed research paper. Copying the quadratic formula is appropriate; copying and pasting a whole paragraph about solving quadratics is plagiarism. **You must convey your understanding in your own words.**

**Planning Guide**

This guide will help you organize and prepare your mathematics research project. It will help you meet all of the criteria required of this project.

Step 1 - Choosing an Appropriate Topic -

Choose a topic that involves mathematics and that is of interest to you. Think about and briefly describe the mathematics involved in the project. If necessary, check with your teacher to ensure it is appropriate.

My Topic:

Mathematics Involved:

Step 2 - Conducting Your Research

You will need to find data related to your topic to analyze and interpret. This data may be informational or statistical in nature. You need to access your data from more than one source so that you can compare and evaluate the validity of the sources.

Where will you go to find the information/data you need? Is it readily available? Explain.

Once you have found the information/data, explain how you know the data is valid.

Step 3 - Interpreting the Data

Interpret your data. It is possible that a mathematical interpretation of your data will require mathematics you haven't studied yet. If that is the case, check with Mr. Phelps. Mathematical calculations are important but your interpretation of data is just as important for this research project.

How will you present your interpretation of this data? Some data might be displayed in a graph. Other data might be presented in a chart or by showing your calculations. Provide a brief description of your interpretation of the data below.

Did you encounter any controversies or multiple points of view in your research? If so, explain below what those are.

Step 4 - Preparing Your Presentation

You now have your topic, data, and an idea about how to interpret that data. Your next step is to prepare your presentation. This must be done in Google Slides.

Your presentation must include:

* Your topic
* Your data
* An analysis of the validity of your data sources
* A description of the multiple points of view and controversies, if applicable
* An interpretation of your data including any predictions and conclusions you can reach

**Research Topics**

1. **Statistics in Sport**

**Moneyball** is a 2003 book by Michael Lewis, which was later turned into a movie starring Brad Pitt. The book and movie follow the 2002 Oakland Athletics, who successfully used statistics to find value in players who didn't cost much in salary.

Your Task

Collect Data and Validate Sources

* Research statistics and salaries from a professional sport of your choice. For example, you might research the NHL and examine 40 players to compare their salary to the number of goals scored last season. You could research the NFL and compare the starting quarterbacks for each team in terms of salary compared to passing

Analyze and Present Data

* Determine any correlation between the statistics you chose to collect. Is there a trend? Are there any outliers?

Present Multiple Sides

* Identify any controversies and present multiple sides of the issue with supporting data. In the example above, you might consider questions like (but not limited to): Do the highest paid players always perform the best? What other factors influence how an individual player performs? Which player was the best bargain? Which player was the biggest bust? If you were putting together a team, which statistics would you look at, and why? Would this "Moneyball" approach work in the sport you have chosen?

1. **World population growth**

In 2012, the world population surpassed 7 billion people. Some people feel that the population is growing too fast, and that our resources aren't sufficient to sustain us on this planet, given our current growth rate. Others believe that the growth is leveling off.

Your Task

Collect Data and Validate Sources

* Research the historical growth of the population on earth.
* Justify the validity of your sources.
* Research what the experts are saying.

Analyze and Present Data

* You might want to graph this data. Are there any trends? Can you make any predictions about population growth?
* Does your prediction match the experts? What factors need to be considered in making these predictions? What factors will influence whether the predictions prove to be correct?

Present Multiple Sides

* Identify any controversies and present multiple sides of the issue with supporting data. You might look at questions like (but not limited to): Are our resources sufficient to support our population growth? What controversies surround population growth?

1. **Minimum Wage VS Unemployment**

Conventional wisdom suggests that raising minimum wage will increase unemployment. A paper written in September of 2011 by Jeremy R. Magruder contends that the opposite is true. The paper is available here:

<http://www.econ.yale.edu/conference/neudc11/papers/paper_272.pdf>

Your Task

Collect Data and Validate Sources

* Collect data from a province or country that increased its minimum wage. Compare the unemployment rate prior to that increase with the unemployment rate after the increase.
* Justify the validity of your sources

Analyze and Present Data

* Analyze the data and determine what affect that increase had on the unemployment rate.

Present Multiple Sides

* Identify any controversies and present multiple sides of the issue with supporting data. You might look at questions like (but not limited to): Does the data support or refute the article written by Magruder? Could any trends be attributed to other factors?

1. **Grade Inflation at College**

Articles like "A History of College Grade Inflation" by Catherine Rampell (Exonomix, July 14, 2011) claim that grades in college courses have been increasing since 1960, despite the fact that students aren't as studious as they were in the past.

Your Task

Collect Data and Validate Sources

* Research the issue of college and/or university grade inflation by collecting relevant data.
* Justify the validity of your sources.

Analyze and Present Data

* Analyze the data you have collected. Examine any trends. Speculate on the causes.

Present Multiple Sides

* Identify any controversies and present multiple sides of the issue with supporting data. Explore questions like (but not limited to): Is grade inflation a real phenomenon? If so, what might be the factors contributing to grade inflation. If not, what is wrong with the data in Catherine Rampell's article?

1. **Cost of Post Secondary Education**

Tuition at post-secondary institutions tends to increase year after year. Recently, major protests took place in the province of Quebec by students who were opposing tuition increases. Research the history of tuition costs in a Canada, or in a specific province. Use the data to make a prediction about the future of tuition costs.

Your Task

Collect Data and Validate Sources

* Research the historical cost of tuition in a region of Canada, or in all of Canada.
* Justify the validity of your sources.

Analyze and Present Data

* Analyze the data you have collected. Explore questions like (but not limited to): What will my tuition cost next year? How much will my children's tuition cost? How much did my grandfather's tuition cost?

Present Multiple Sides

* Identify any controversies and present multiple sides of the issue with supporting data. Answer questions like (but not limited to): How does tuition in Canada compare to other countries? Who should pay for post-secondary education?

1. **Cost of Home Ownership**

The cost of home ownership has varied greatly over the past century. Research the historical cost of owning a home in a neighborhood of your choice. Compare the cost today to the cost in an earlier generation. You might predict the cost of ownership in 20 years. When considering the cost of ownership, you could consider purchase price, mortgage rates, utility costs, property taxes and other measures.

Your Task

Collect Data and Validate Sources

* Gather data on cost of home ownership in a neighborhood of your choice. You will need current data and historical data.

Analyze and Present Data

* Analyze the data you have collected. Answer questions like (but not limited to): What did homes in this neighborhood cost to own in a previous generation? What might the cost of ownership be in future generations? How do interest rates affect the cost of ownership?

Present Multiple Sides

* Identify any controversies and present multiple sides of the issue with supporting data. Answer questions like (but not limited to): Has anything ever happened in the neighborhood that significantly affected ownership costs? Are people spending too much on homes to be able to make payments if interest rates rise?

1. **Golf Clubs**

Different golf clubs are used for different shots, and they give the ball different trajectories. "Loft," or "loft angle," is a measurement, in degrees, of the angle at which the face of the golf club lies relative to a perfectly vertical face represented by the shaft. Technically, iron loft and wood loft are measured slightly differently, but the effective result is the same.

<http://golf.about.com/cs/golfterms/g/bldef_loft.htm>



Your Task

Collect Data and Validate Sources

* Gather data and research the effect of the loft of various clubs on the trajectory of the shot.

Analyze and Present Data

* Analyze the data you have collected. Answer questions like (but not limited to): How do you determine what club to use? Which club will send the ball the farthest? Which club will send the ball the highest?

Present Multiple Sides

* Identify any controversies and present multiple sides of the issue with supporting data. What are the regulations on golf club production? Why might those regulations be needed?

**Additional Research Project Topics**

**Data Gathering Topics** – Topic selection where the students are going to gather primary or secondary data and then perform some analysis, either statistical or interpretative, to reach conclusions.

1. Stock Investments – Risks vs. Rewards
2. Standardized Test Results – How valid are they? Is there racial/gender/geographic variation?
3. Do great actresses mature earlier than great actors? (exploration of ages of Academy Award Winners)
4. Will females out compete males in the 21st century? (sprinting, distance running, whatever!)
5. Drug use in sports – How does it affect results?
6. How do baseball stadium dimensions affect batting statistics?
7. How do you assess what a player is worth?
8. Climate change – Is it real?
9. Is the complexion of Nova Scotia’s forests changing?
10. How is the changing ocean temperature changing its carbon carrying capacity? What consequences will result for marine life and humans?
11. Are hybrid vehicles actually more environmentally friendly?
12. Investigate carbon dioxide emissions – what are the trends and their implications?

**Exploration and Exposition Topics** – Topics where the students explore a particular area of interest and learn about the mathematics involved. The project should demonstrate a students’ understanding and should be instructive to the reader.

1. How are sports tournament schedules constructed?
2. How do ranking systems work? (college bowl, ELO chess, etc.)
3. How does airline routing work?
4. Explore the math in bridges in general or of particular famous bridges.
5. Explore some of the mathematics in Medicine.
6. Investigate the mathematics of navigation, present or ancient.
7. Research and explain a variety of proofs for Pythagorean Theorem
8. What is up with the Golden Ratio and why does it show up everywhere?
9. What are Fibbonacci numbers, why are they important?
10. How can there be different Sizes of Infinity and how does this matter?
11. UPC codes, how do they work?
12. Prime numbers, their generation and usefulness
13. Genetic Inheritance
14. Research the math behind cell phones, traffic light timing, traffic flow or anti sway in buildings
15. Do video games increase hand eye coordination? Reaction time? Problem solving?
16. Does music / noise affect concentration?
17. Buy local, what’s the data on its benefits?

**Mathematics Research Project Rubric**

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| --- | --- | --- | --- | --- |
| Level  Criteria | Excellent | Proficient | Adequate | Limited \* |
| Collect primary or secondary data related to the topic | Collects data that is **pertinent** and **conclusively** establishes the trend. | Collects data that is **relevant** and **substantially** establishes the trend. | Collects data that is **suitable** and **generally** establishes the trend. | Collects data that is **irrelevant** and **does little to** establish the trend. |
| Interpret the Data | Provides an **astute** interpretation of the data. | Provides a **credible** interpretation of the data. | Provides a **rudimentary** interpretation of the data. | Provides a **flawed** interpretation of the data. |
| Present multiple sides of the issue with supporting data | Presents multiple sides of issue with **precise** supporting data. | Presents multiple sides of issue with **relevant** supporting data. | Presents multiple sides of issue with **basic** supporting data. | **Unable** to present multiple sides, or presents multiple sides of issue with **flawed** supporting data. |
| **Organize and present the research project** | Organizes and presents the research in a **purposeful** and **compelling** manner. | Organizes and presents the research in a **logical** and **effective** manner. | Organizes and presents the research in a **reasonable** and **simplistic** manner. | Organizes and presents the research in a **disorganized** and **ineffective** manner. |

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| --- | --- | --- | --- | --- |
| **Criteria** | **Description of Criteria** | **Yes** | **Not Yet** | **Teacher Comment** |
| Assess the accuracy, reliability and relevance of the sources of the data collected | The student has critically analyzed the sources of data and discussed their accuracy and reliability. |  |  |  |