Name: _____ Partner: _____ Band: _____

Linear Programming & Optimization
Algebra 2 Quarter 1 Benchmark

<u>**FINAL DUE DATE**</u>**: Friday, 11/13, at the beginning of class, in digital form uploaded** ▒▒▒▒▒ ***NO LATE PROJECTS ACCEPTED due to grades closing on 11/18.***

<u>*Intermediate Deadlines*</u>**:**
- Friday 10/30: Partner choices due ▒▒▒▒▒
- Thursday, 11/5: Products due for business (beginning of class)
- Friday, 11/6: Constraints due for business (end of class)
- Monday, 11/9: Graph, Intersection points, and Revenue Equation due

Project Overview:
For our first quarter benchmark, you and one partner will be creating a start-up business together, and you will be applying your knowledge of linear programming to determine how to optimize your business' financial situation. You **each** must generate and solve a linear programming model in order to optimize the financial gains for your company for **two** different types of products (1 per person).

<u>You will need to</u>:
- Provide basic information about your company (e.g. company name, type of business, etc.). **(Group)**
- Choose two types of products that your company will make (e.g. sneakers and shirts, TVs and stereos, etc.). **(Group)**
- For each type of product, one of you must choose at least two specific products that your company will make (e.g. if you choose sneakers and shirts, then for sneakers, you could choose basketball and running sneakers, and for shirts you could choose short sleeve and long sleeve). **(Group)**
- Identify each product using a variable and decide on a maximum or minimum number of each type of product your company will produce per day (or per week/month/year etc.). *Do research in order to make this as realistic as possible*! **(Group and Individual)**
- Graph the feasible region <u>by hand</u> and find the coordinates of the vertices for **each type** of product, so you will have **2 total** (e.g. you will have one graph for sneakers, and another for shirts). **(Individual)**
- Write the equation of the function you want to optimize for each product **(2 total)**, and decide whether you need to maximize or minimize it. **(Individual)**
- Use the optimization equation to determine how many of each product for each type you should produce **(2 total)**. In other words, identify the appropriate combination of products that will maximize profit for each type of product. **(Individual)**

Project Requirements:
Since you will be working in partners but each generating your own linear programming problem for your business, you will be graded based on both individual and group requirements.

Individual Requirements:
1. Generate and solve a linear programming situation that will enable you to determine

how many of each product you should produce.
2. Create a polished graph *by hand* with your feasible region, all equations, all vertices and all axes clearly and neatly labeled.

Group Requirements:
1. Come up with a company name, and identify the products that you will be producing.
2. Create a 3–4 minute video that will be sent to potential investors. This video should explain what types of products your company will be producing, as well as what combination of products would maximize profit, with sufficient mathematical support provided in the video.
3. Create a detailed process guide to explain how to use systems of equations and linear programming to create an effective business model. In your process guide, you should include **both** of the individual linear programming problems that you and your partner created, as well as step-by-step descriptions of how to solve linear programming problems (using your own problems as examples). Additionally, in your process guide, you must illustrate **all three** methods for solving systems of linear equations that we have studied (graphing, substitution, and elimination). The creation of this process guide can serve as a blueprint for the expansion of your business or additional businesses in the future. As a group, you will also be held accountable for coordinating the work between partners, and for making sure that your final process guide meets all requirements. Your final process guide should be polished (all must be typed), must include graphs (generated and labeled using graphing software) and should be written in complete sentences using proper grammar and sentence structure.

Algebra 2 Checklist of Required Topics

Individual Requirements:
- Generation and solution to an original linear programming system as co-CEO of your own start-up company. This model should include:
  - Basic information about your company (e.g. company name, type of business, etc.)
  - Choose two products your company will make.
  - Information about the two products your company will produce and accompanying constraints
  - *Hand-made* graph of the feasible region and identification of coordinates of the vertices, along with properly labeled axes.
  - Equation of the function you want to optimize, and discussion about whether you will be maximizing or minimizing it.
  - Use of optimization equation to determine how many of each product you should produce.

Group Requirements:
- **A polished process guide** which explains how to use linear programming to create an effective business model. This guide must include:
  - Introduction
  - All mathematical components of the 2 linear programming models (i.e. calculations, computer generated and labeled graphs, solutions, etc.)

- o   A demonstration of how to use **all three** techniques to solve a system of equations (graphing, substitution, and elimination)
  - o   Explanation/interpretation of what the math means and how to use linear programming from a business perspective
  - o   Your final process guide should:
    - ▪ Be polished (typed!), well organized, and grammatically correct
    - ▪ Include all requirements
- **A 3–4 minute video** explaining what types of products you will be making, as well as an overview of the numbers of products that will maximize profits for specific products (in other words, your video should include the answers to each of your linear programming problems). This video should include:
  - o   Recommendation about what combination of products will maximize profit
  - o   Mathematical support for your business recommendation

Essential Questions
- How can situations involving multiple variables be represented/solved using systems of inequalities?
- What information does a graph give us?
- How can situations involving more than two variables be solved?
- How can real-world situations be modeled using Algebra?

Core Values

Inquiry:
- What is linear programming and how is it connected to systems of inequalities?
- How can we use linear programming to optimize business conditions?
- How many variables can be used when solving systems of equations?

Research:
- What are some real-world applications of systems of equations/inequalities and linear programming?

Collaboration:
- Work with a partner to create a polished business proposal for potential investors.

Presentation:
- Present business proposal and video to classmates.
- Polished process guide can be used to introduce systems of inequalities and linear programming to other Algebra classes.

Reflection
- Journal at the conclusion of the benchmark focusing on the project itself, you and your partner's effort, your final product, and what you learned through the process.

ALGEBRA 2 – Linear Programming & Optimization   Name: _____

	Exceeds Expectations 20-19	Meet Expectations 18-16	Approaches Expectations 15-13	Does NOT Meet Expectations 12-0
Design (group) (Planning; organization; research; understanding of project) **10 points = process guide** **10 points = video**		Thoughtful and careful planning. Good understanding of purpose of the project. Process guide is well organized and designed. The main insights are conveyed clearly in both process guide and video.		
Knowledge (individual) (Research; understanding of concepts; use of correct terms, formulas, and diagrams)		Research about linear programming is fairly thorough, and key ideas/details are selected with care. All sources are cited. Solution for linear programming model is accurate. Accurately solved system using at least 2 methods.		
Application (individual) (Understanding of real-life applications)		Carefully explained in process guide and video how linear programming is used to optimize business choices. Clear demonstration of step-by-step process to set up and solve a linear programming model.		
Process (individual/group) (Collaboration; fulfillment of project deadlines and requirements; journal entry) **10 points = individual** **10 points = group**		All parts of the project, including process guide, video, & intermediate assignments, are completed on time and meet the necessary requirements. Different parts of the project are thoughtfully coordinated between partners. Work periods are utilized very well.		
Presentation (group) (Communication of ideas and concepts; sense of audience engagement) **10 points = process guide** **10 points = video**		*Process guide* – well planned and designed, clear, & informative. Correct punctuation, grammar, & spelling. *Video* – well planned and designed, clear, & informative. Good attention to details (timing, visual aids, flow of information, audience engagement).		