Game economics and balancing

Understanding game design and the games business through math

Aalto University, Game Analysis course

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Why?

1. Math can give you a consistent and roughly correct initial guesses
   - Final solution then iterated through playtesting & A/B testing
2. A spreadsheet or a Colab notebook can make it easier to update many things at once
   - Change one number to get and visualize, e.g., new character stats for all levels
   - A game prototype with a single level does not need a spreadsheet and design by math, but defining values using math is basically a form of automation needed when the game is scaled up to multiple levels, characters, weapons etc.
   - Especially relevant in games as a service, where you need to model and predict how the game should evolve over years, with players feeling like they make progress, and an engaging experience provided for both old and new players

Iain Compton:

“A lot of game design is done in an Excel sheet. As a rule of thumb, design starts in a text document and ends with a spreadsheet.

As a designer a lot of things are dependent on numbers. Experience points, damage, hit points, currency, etc. A lot of those have complex inter-relationships too. As a designer you will want to be able to model things before making balance changes. If you increase one number by a certain amount, how much does it affect a different number? How long does it take a player to go through your content? How much currency should a player have at a certain point in the game? And so on. You will need to be able to create reasonably complex algorithms that take several numbers from different systems and output a number that matches your design parameters. For example, in a shooter that I made, the player got an amount of XP and in-game currency after each match. Those rewards had to fall into a specific range of numbers but the inputs could be wildly different due to players of different skill levels, time spent in the match, etc. I had to create an algorithm that rewarded skill but didn't punish failure and that gave incentives for staying in the match to the end even for a team that was clearly outmatched. That is a pure maths problem.”

A highly marketable skill

- Especially in F2P, knowing how to design and model game balance and economy can be crucial
- A final assignment from 2018 that basically landed the student a game designer job (shared with permission): https://docs.google.com/spreadsheets/d/1ziuQmP2XTDIGUFvi_R6GlClitmbPm47wAVpb1pAq7do/edit#gid=1054610195

“If you want to be a game design for mobile AND console or PC, you need to have a good understanding of the things you're going to learn in this course. It's crucial, even if you don't want to do any system heavy games, 3/4 of the games have some sort of system that needs to be designed and then balanced. Even narrative-focused indie games like Amnesia have systems like health, oil for the lamp etc, and those systems need to be crafted. So, enjoy this course and try to get as much as possible out of it if you want to do some game design in the future. Regarding my experience, I was hired mainly because I was able to showcase some practical balancing knowledge from this course.”

The job interview process

- - 4 interviews
- - 10% my life and studies
- - 60% "Hey, I've got this Hearthstone Analysis I did few months ago, do you wanna check it out?"
- - 30% discussions about games and why certain companies made some game design choices here and there.

Job in practice:

- - 40% creating and balancing systems on google sheet and ensure that they can be implemented in the game with the current tools
- - 30% Designing features and writing detailed documentation about it
- - 30% define detailed UX flows and user paths for each feature

Game balancing

- Overall: determining the numbers/parameters of the game.
- Challenge level appropriate for the audience?
- Balance of starting positions?
- Balance of multiple strategies?
- Balance of objects such as cards, battle units?

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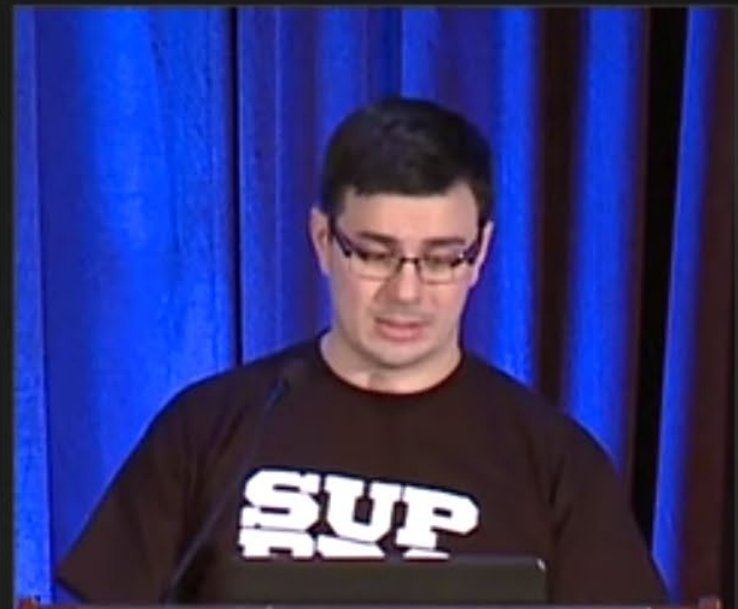
INTRODUCTION

- Stefan Engblom
- Game designer / Clash Royale / Supercell
- Balancing, economy, system design

SUPERCELL



UBM

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Three ways of balancing

- Use math and simulations (transitive and intransitive relationships)
- Use your design instincts
- Use playtesting
- Generally, a good idea to start with math if it’s feasible

Two main types of relations

- Transitive relationships: cost/benefit curves
- Intransitive relationships: rock-paper-scissors, every unit has both weaknesses and strengths, wins some but loses to others

Balancing intransitive relationships

- Key principle: every attack must have a counter)
- Rock-paper-scissors is balanced because every choice has equal opportunity of winning and losing

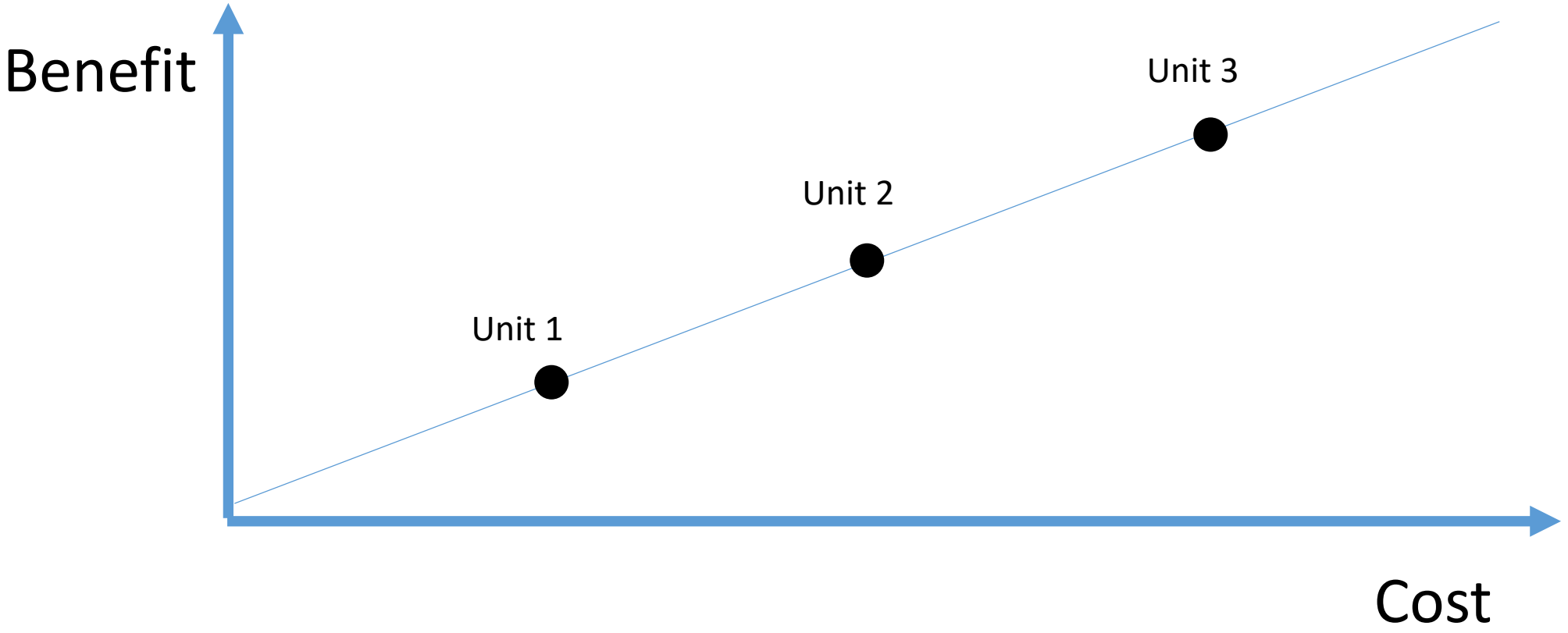
Intransitive relationships in Clash Royale

			
		WIN	LOSE
	LOSE		WIN
	WIN	LOSE	

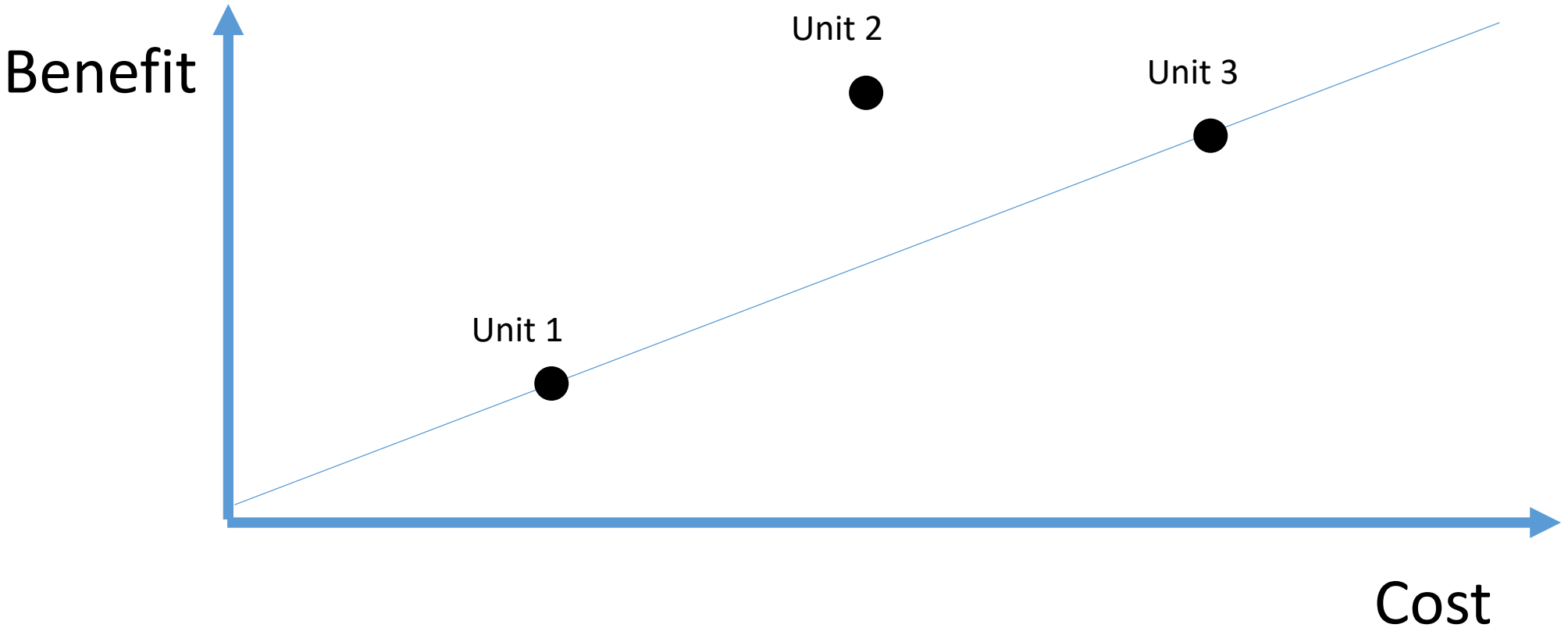
Balancing transitive relationships

- Design based on ”cost curves” – general relationships of variables such as item cost and item benefit (e.g., elixir cost vs. damage per second and hit points in Clash Royale)
- Rule of thumb: All units should have approximately equal cost/benefit ratio.
- Challenge: How to make at least some units feel very powerful at the same time?

Linear cost curve: a reasonable default



Why is this not good?



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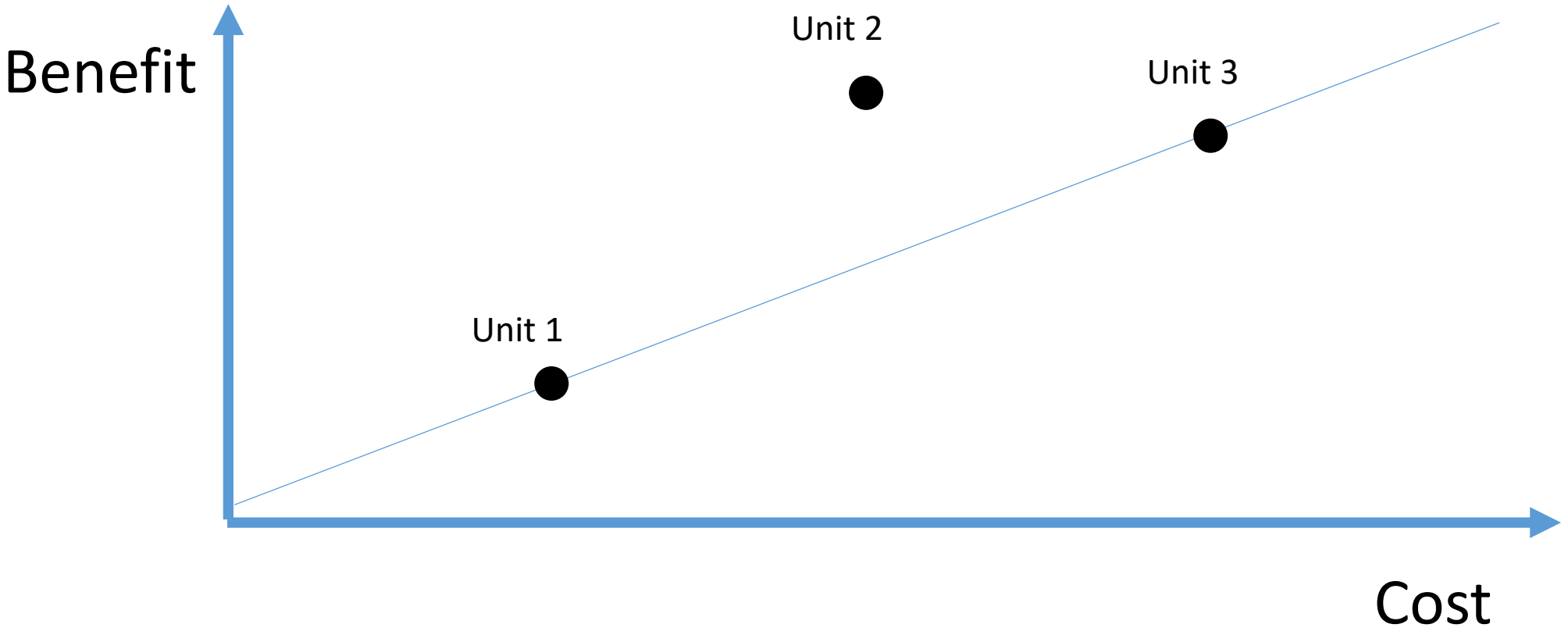
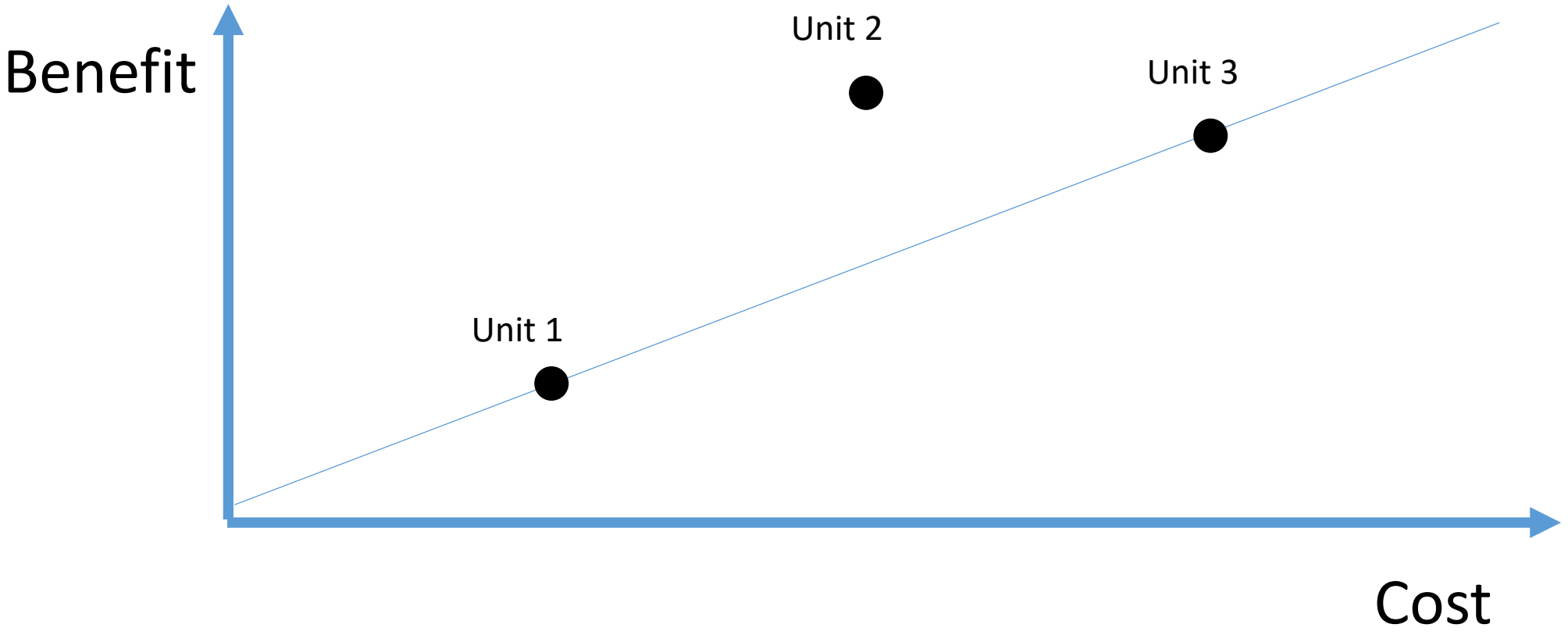
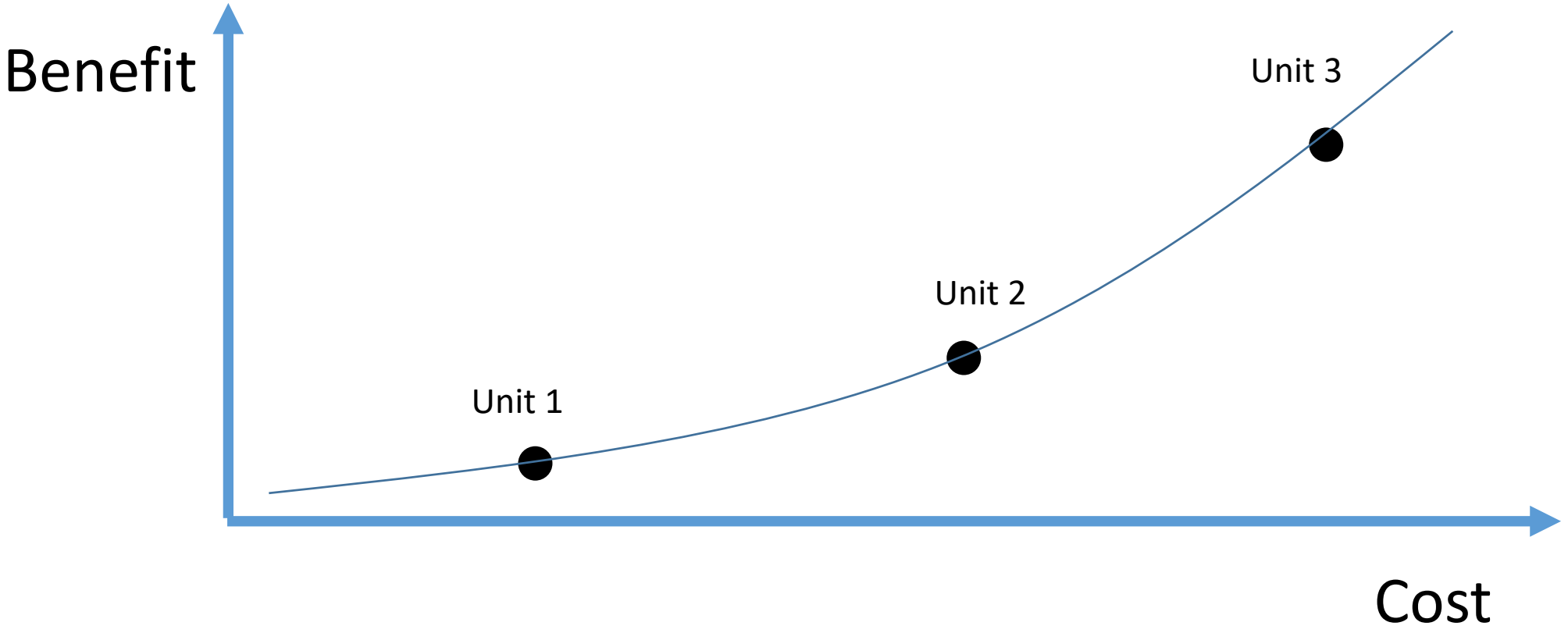


Less interesting decisions and diversity of gameplay

What exceptions to the rule?



Why sometimes a nonlinear curve?



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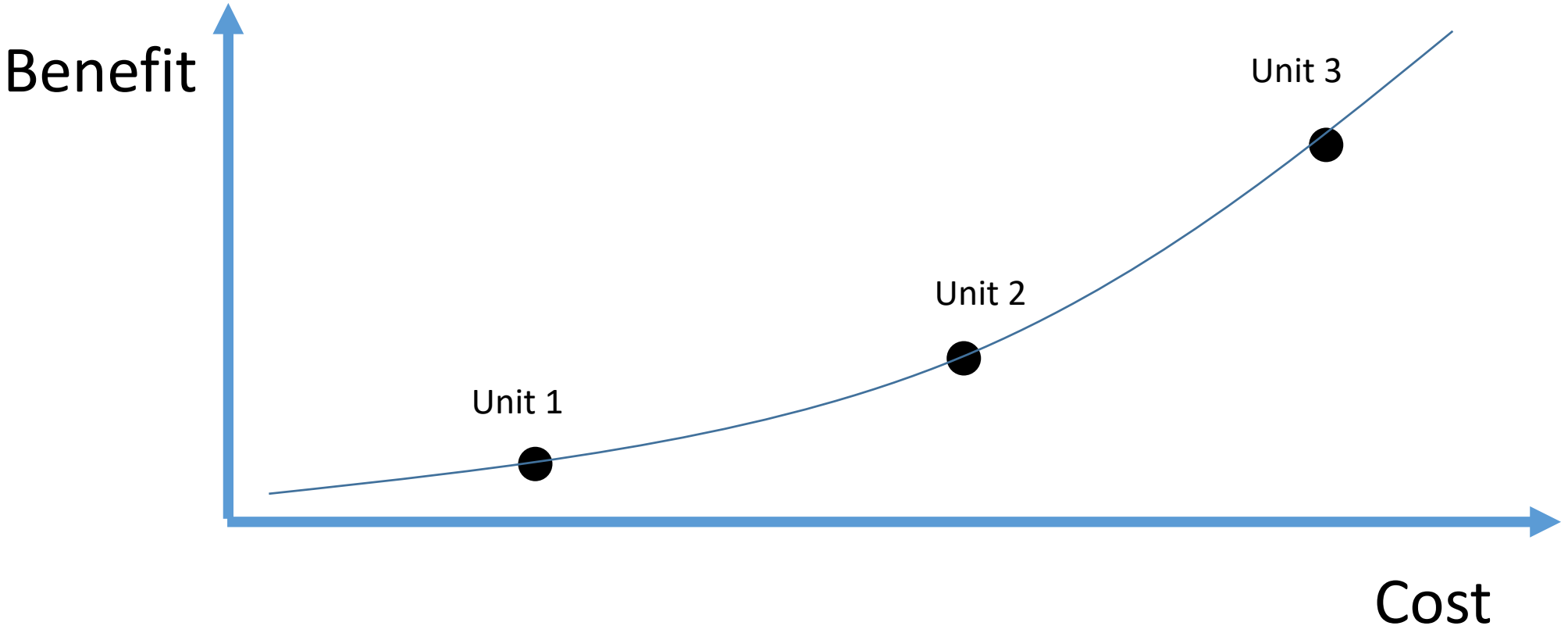
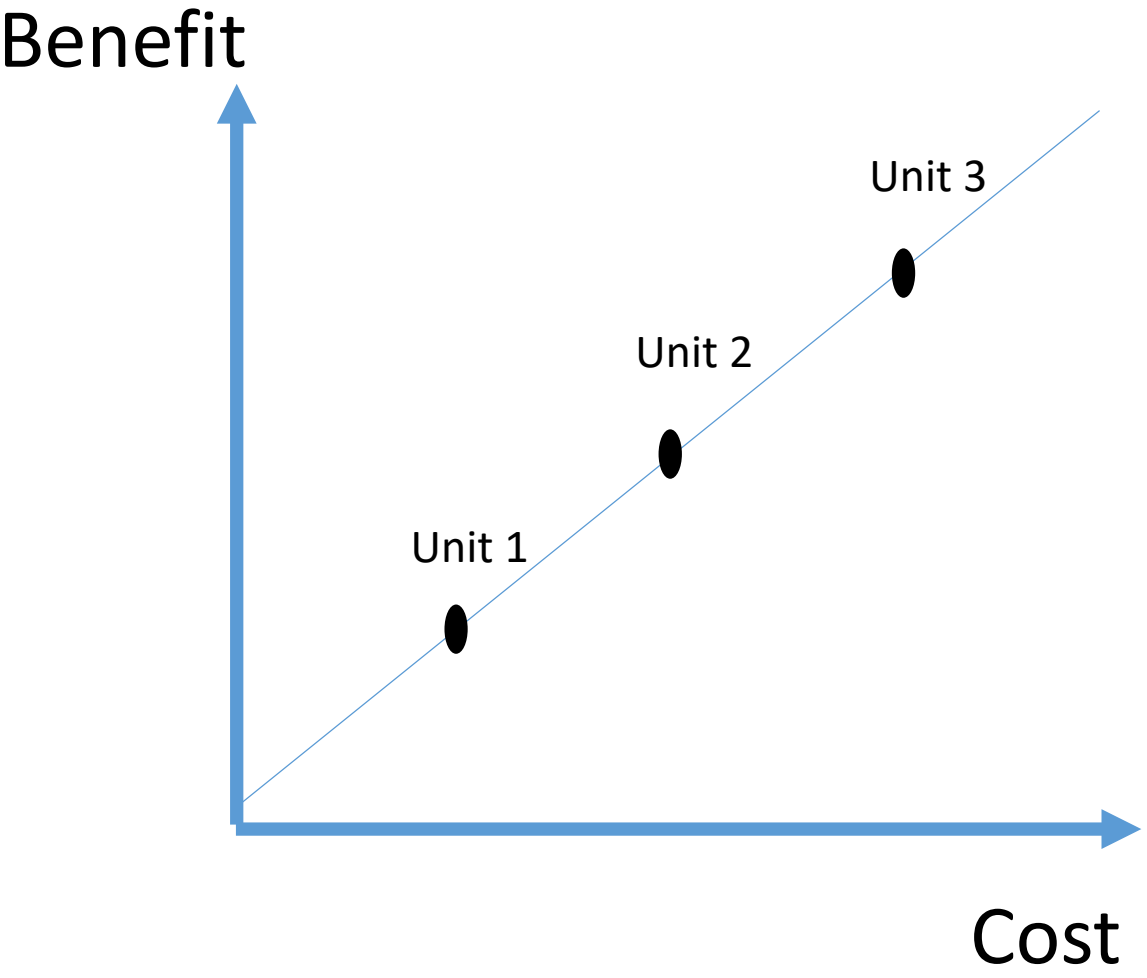
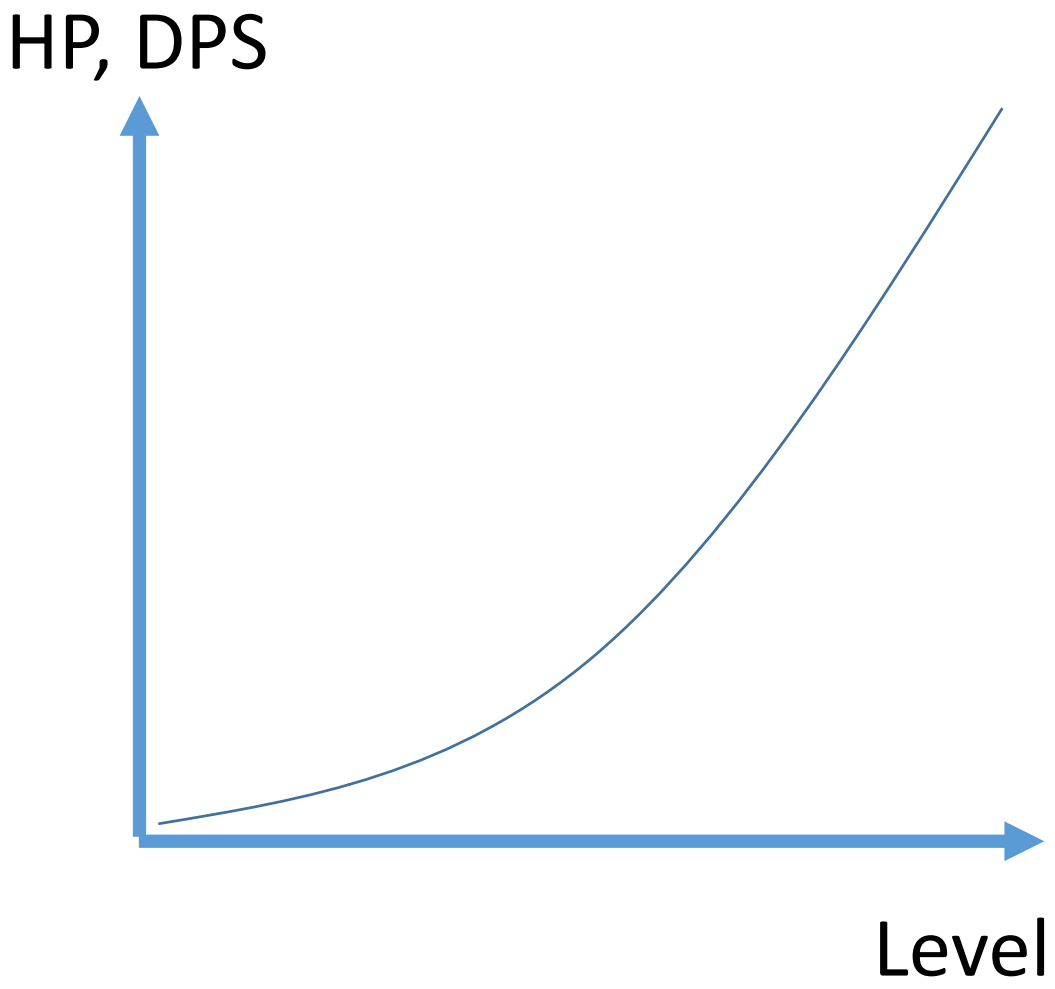


Hearthstone: increasing mana pool => high-cost units only usable late in the game => must have higher benefit

Remember that these can and do coexist





Weber’s law: exponential growth is perceived as constant (perception is logarithmic)

Balancing summary

- Math & spreadsheets are a good starting point
- Playtesting still needed, because not everything can be modeled
- Cost-benefit curves (balancing transitive relationships)
- Rock-paper scissors (balancing intransitive relationships)

Rest of the day: Clash Royale balancing

- Everyone goes through the Clash Royale balancing Colab in their own pace.
- You can also continue on the previous notebook, everyone makes as much progress as they can in this time.
- If you feel confident on your own, you can leave the Zoom.
- I will stay here to help, we can go to a breakout room for one-on-one tutoring where you can share your screen.
- Before tomorrow, also try to find time to play Walking Dead No Man’s Land (complete 1-2 chapters)

Resources

http://www.gdcvault.com/play/1024272/Quest-for-the-Healthy-Metagame

https://gamedesignconcepts.wordpress.com/2009/08/20/level-16-game-balance/

http://gamebalanceconcepts.wordpress.com

http://rubycowgames.com/excel-and-google-docs-spreadsheet-tips-for-game-designers/

http://rubycowgames.com/excel-and-google-docs-spreadsheet-tips-for-game-designers-2/

http://www.gamasutra.com/view/news/36675/Opinion_Stop_Being_The_Useless_Designer__Excel_and_Formulas_.php

http://www.mitchzamara.com/essays/spreadsheet-functions-for-game-designers-part-1/

http://www.mitchzamara.com/essays/spreadsheet-functions-for-game-designers-part-2/

http://forums.rpgmakerweb.com/index.php?/topic/17393-excel-game-balance-workbook-data-sample/

http://iquilezles.org/www/articles/functions/functions.htm

https://www.quora.com/How-is-math-used-in-video-game-designing-and-programming