

# Analysis of player's in-game performance vs rating: Case study of Heroes of Newerth

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- ◆ Ranking and rating of players in online multiplayer match based games
  - Mostly evolved from Elo rating system developed for chess
  - Only take into account the outcome of the match
- ◆ Are the in-game performance parameters reflected well in the assigned rating?
- ◆ Analysis of the correlation between in-game parameters and the rating assigned by the game's rating system
- ◆ This study confirmed several anomalies and weaknesses in rating system which can be exploited by the players

# Outline

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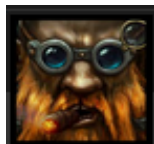
- ◆ Problem
- ◆ Introduction
- ◆ Methodology
- ◆ Results
- ◆ Conclusion

- ◆ Player ranking
  - Player's position on a list of players of specific game based on rating
- ◆ Player rating
  - Numerical skill indicator assigned to specific player or team
- ◆ Match based games
  - First Person Shooters
  - Real Time Strategies
  - MMORPGs
  - Multiplayer Online Battle Arenas (MOBA)
  - ...
- ◆ Case study: *Heroes of Newerth* (MOBA)
  - Match making rating - MMR

- ◆ A “player created” game genre
- ◆ Popularized by *Defence of the Ancients* custom map for Blizzard’s Warcraft 3
  - *Sacrifice* by Shiny Entertainment
  - *Aeon of Strife* - map for Starcraft
  - Dota suppressed the popularity of “mother game” - Warcraft 3
  - “Stand alone” MOBA games such as League of Legends (LoL), Heroes of Newerth, Demigod...
- ◆ Mostly free to play bussiness model, but REAL games
  - WoW 12 million monthly users - LoL 35 million
  - CoD MW 3 million daily users peak- LoL 12 million
  - Top 100 games on steam 650k concurent users - LoL 3 million\*
  - Halo 2 billion hours of play since 2004 - LoL 1 billion a month

- ◆ Match based
  - Each match starts a new
  - Match statistics and outcome saved
  - Long term goal - improvement (rating, skill, statistics...)
- ◆ Team based - two opposing teams
  - Up to 5 players per team
  - Goal - destroy opposing teams main building
- ◆ Heroes
  - One per player
  - Unique skill subset per hero
  - Various roles
  - Improved through gathering experience and equipment

# Hero skills and roles- example




## HERO: ENGINEER

NUMBER OF ALT AVATARS: 3


PLAY STYLE: CC MAGIC

PREV HERO NEXT HERO




**Q THE KEG** RANGE: 800 | MANA COST: 80,100,120,140 Simple ▶

Target a location to deal **100 / 150 / 200 / 250 Magic Damage** and a **1.25 / 1.5 / 1.75 / 2 second Stun** in an area around that position. Units hit with this ability are pushed away from the impact. Engineer can be pushed himself, but not damaged or stunned.




**W STEAM TURRET** RANGE: 800 | MANA COST: 100 Simple ▶

Click and drag cursor to create a turret that shoots in a cone for 5 seconds. Deals up to **100 / 200 / 300 / 400 Magic Damage** and pushes enemies away. Slows Movement Speed for **3.5%** per bullet, for a max of 35% slow.



**E SPIDER MINES** MANA COST: 90,100,110,120 Simple ▶

Activate to place a Spider Mine at your location. Up to 9 may be placed at once, each dealing **150 / 200 / 250 / 300 Magic Damage**. Consume one charge to place a mine. Up to **1 / 2 / 2 / 3** charges may be stored, refreshing every 30 seconds. Spider mines are stealthed and appear when an enemy comes near them, chasing them until contact. Each mine grants vision around itself.



**R ENERGY FIELD** MANA COST: 200 Simple ▶

Activate to create an Energy Field for **6 / 8 / 10 seconds**. Deals **50 / 75 / 100 Magic Damage** per second. Enemies who enter or exit the Field take **100 True Damage** and a **2 second Silence**.



# Hero improvement



Hero of starting level  
with starting items



Hero of maximum  
level with advanced  
items



- ◆ None Player Characters
  - Spawn periodically for each team (creeps)
  - Grow in strength
  - Neutral
- ◆ Reward/penalty system
  - Killing blows
  - Destroying buildings
  - Dying
- ◆ Map vision (fog of war)
  - Static buildings
  - Dynamic - friendly units and wards



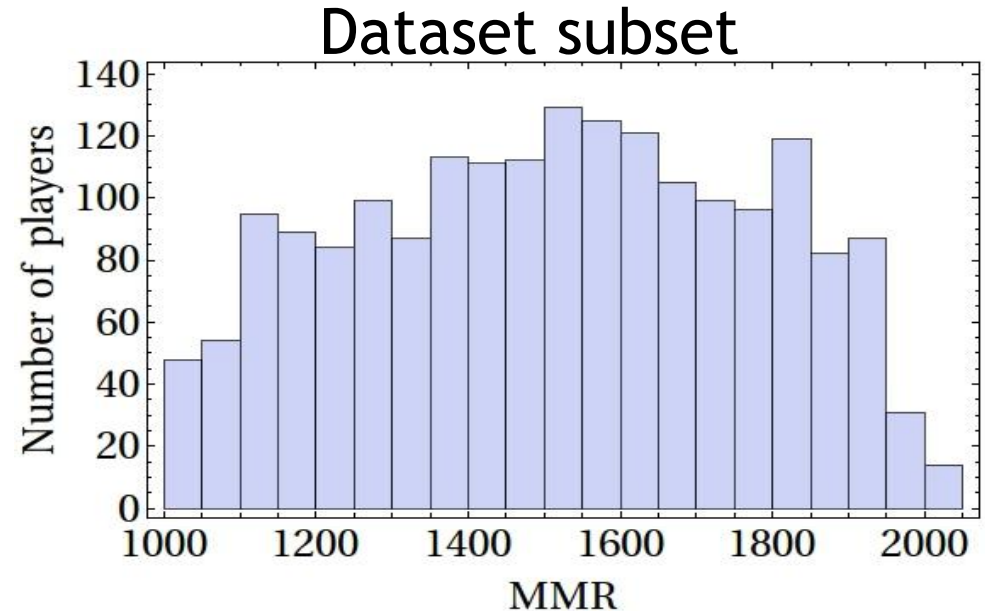
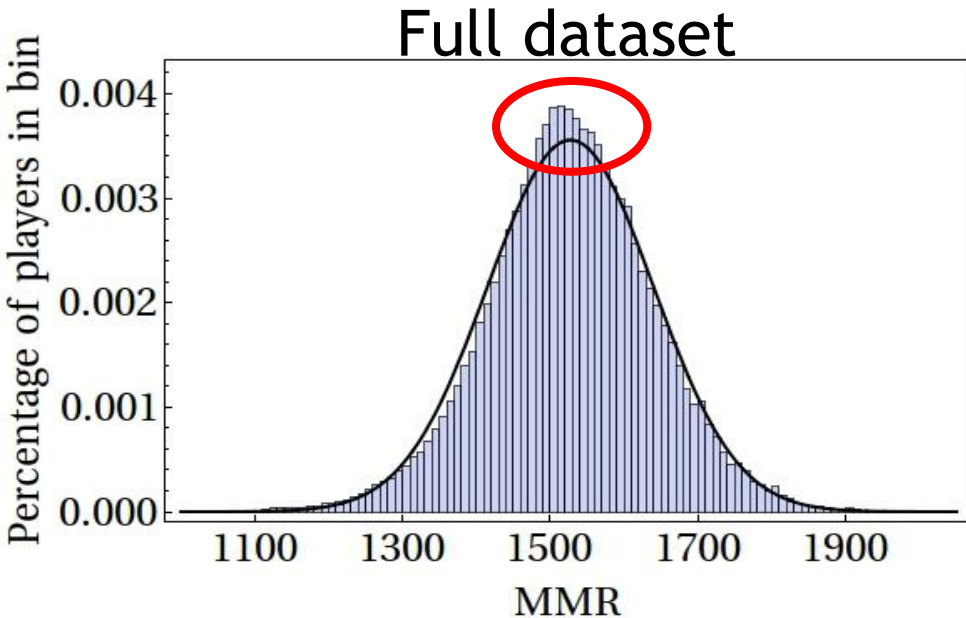
HoN Map with  
indication of creep  
pathways



Hero killing a creep and  
earning experience and  
gold

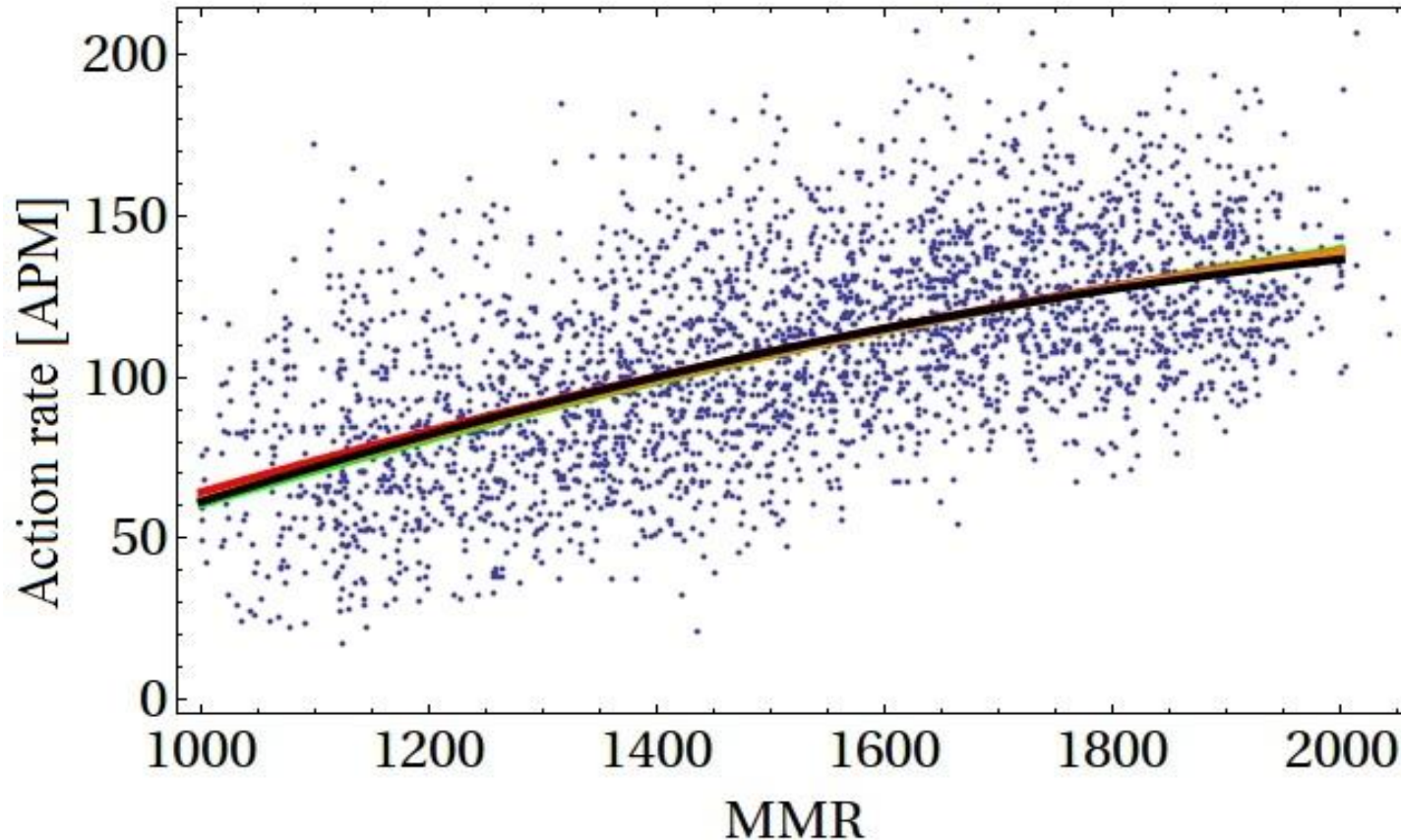
- ◆ Player rating data - HoN's official web site
- ◆ Supplemental data - [www.honedge.com](http://www.honedge.com)
  - Used to obtain data by querying game database
  - No longer possible
- ◆ Dataset includes
  - 338,681 player
  - Active within 30 days before 19.10.2012
- ◆ Dataset subset
  - For computational and presentational purposes
  - ~ 3000 players
  - Higher chance of picking players with MMR of
  - Beta distribution used for sampling so sample

# Dataset statistics



- ◆ Whole dataset well described with normal distribution
- ◆ Slight incline around 1500 rating (starting point)
- ◆ Dataset subset limit on 1950 and 1050 rating

# Validation of sampling



- ◆ Five different subseets created and plotted

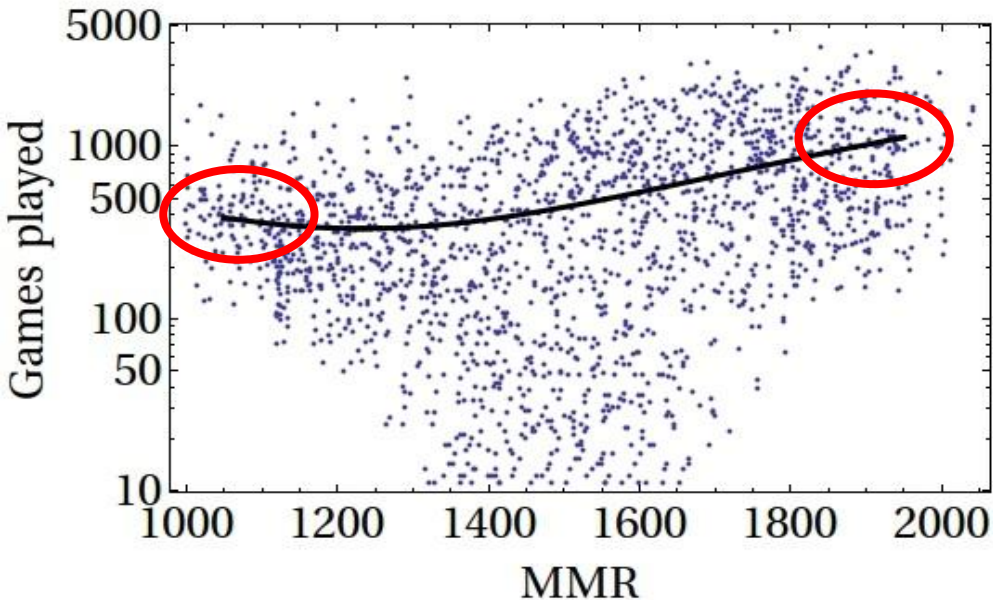


*Are the in-game performance parameters reflected well on the assigned rating?*

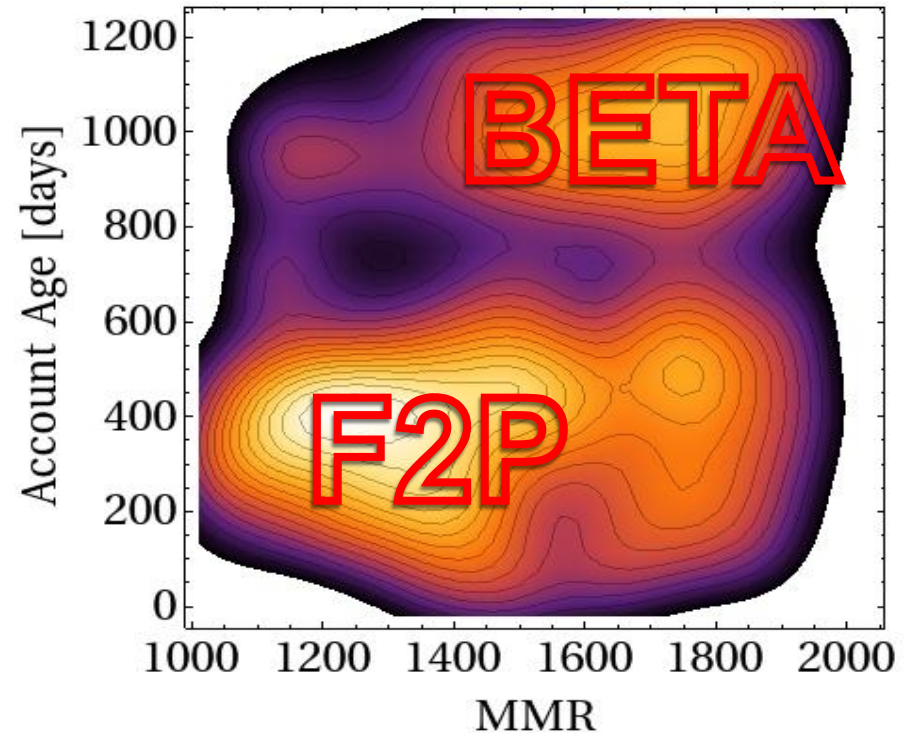
- ◆ All parameters fitted to  $1 + a \cdot MMR + b \cdot MMR^2$  dependency
- ◆ Parameters investigated:
  - Number of games played
  - Account age
  - Win/loss ratio
  - Kill/death and assist/death ratio
  - Gold and experience per minute
  - Action rate
  - Denying
  - Wards per minute
  - Game duration

# Games played & account age

Logaritimic scale



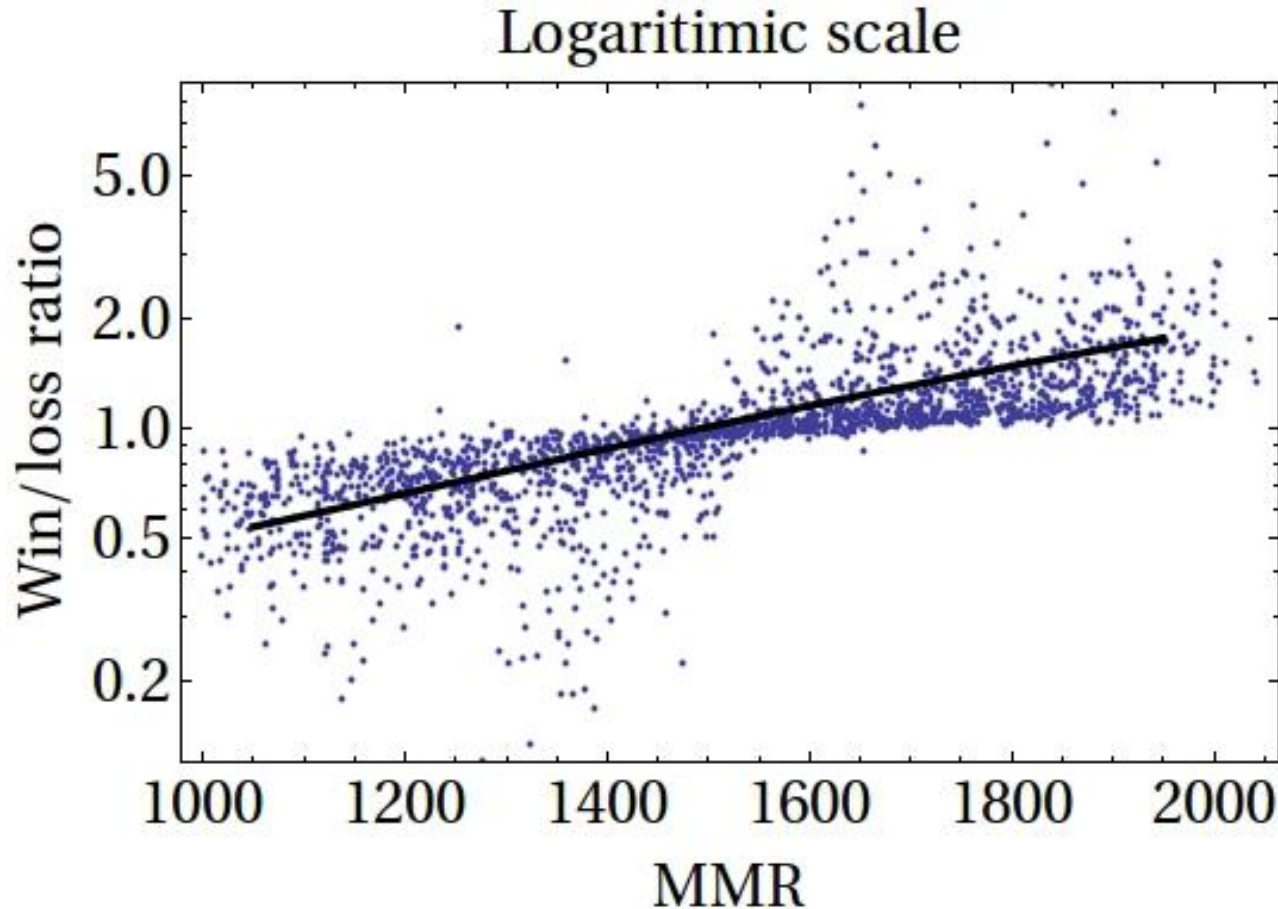
Linear Scale – Heat Map



- ◆ More games - not always higher rating
- ◆ Very evident beta end and switch to F2P model

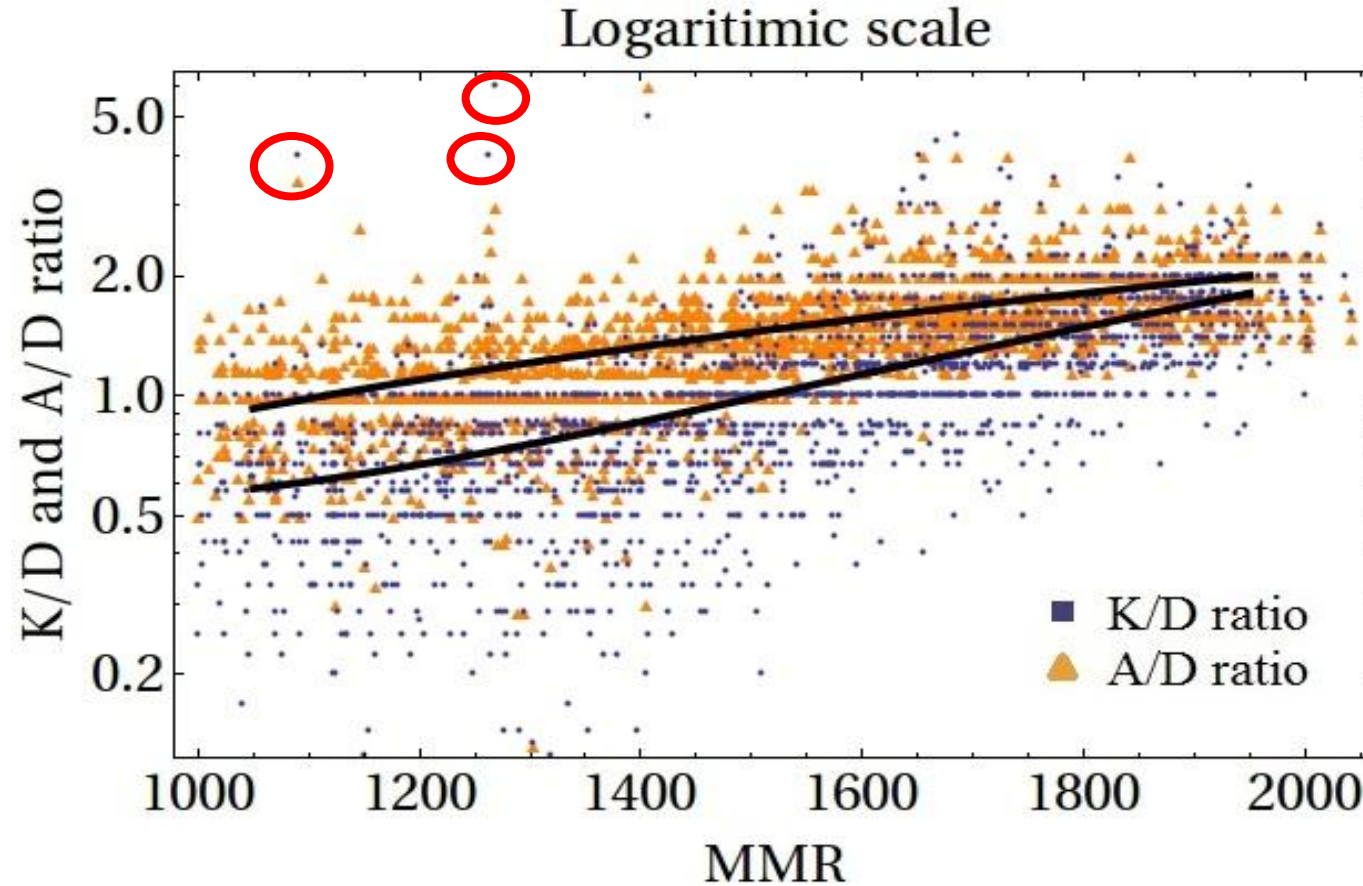


# Win/loss ratio



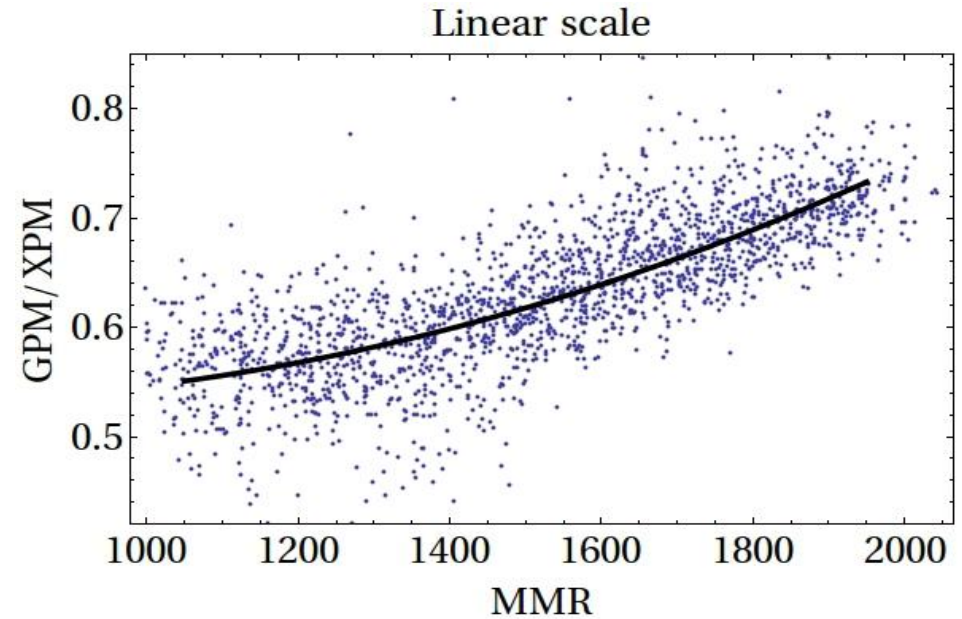
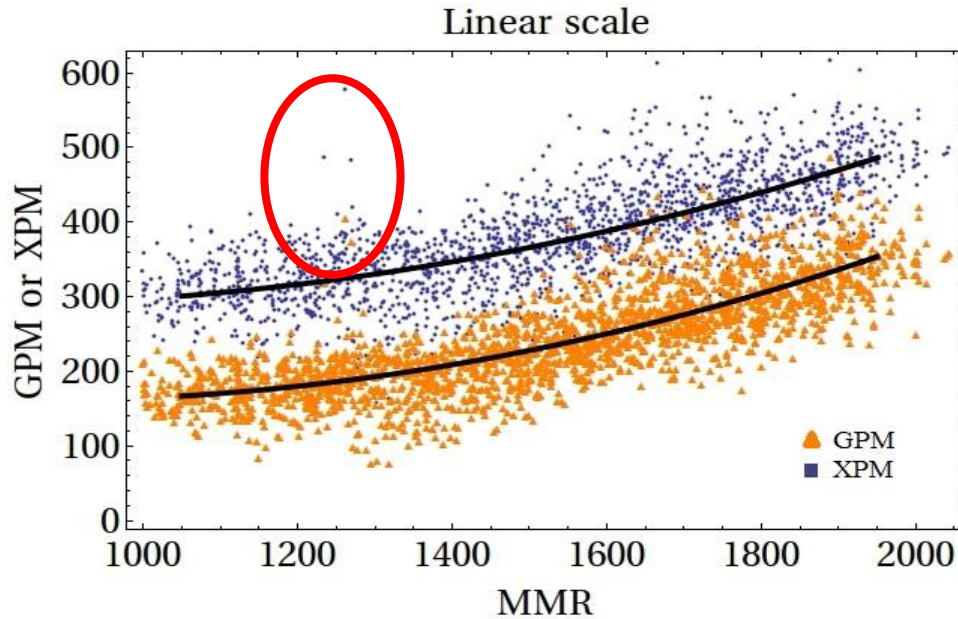
- ◆ Win more - get better rating 😊

# Kill/Death & Assist/Death

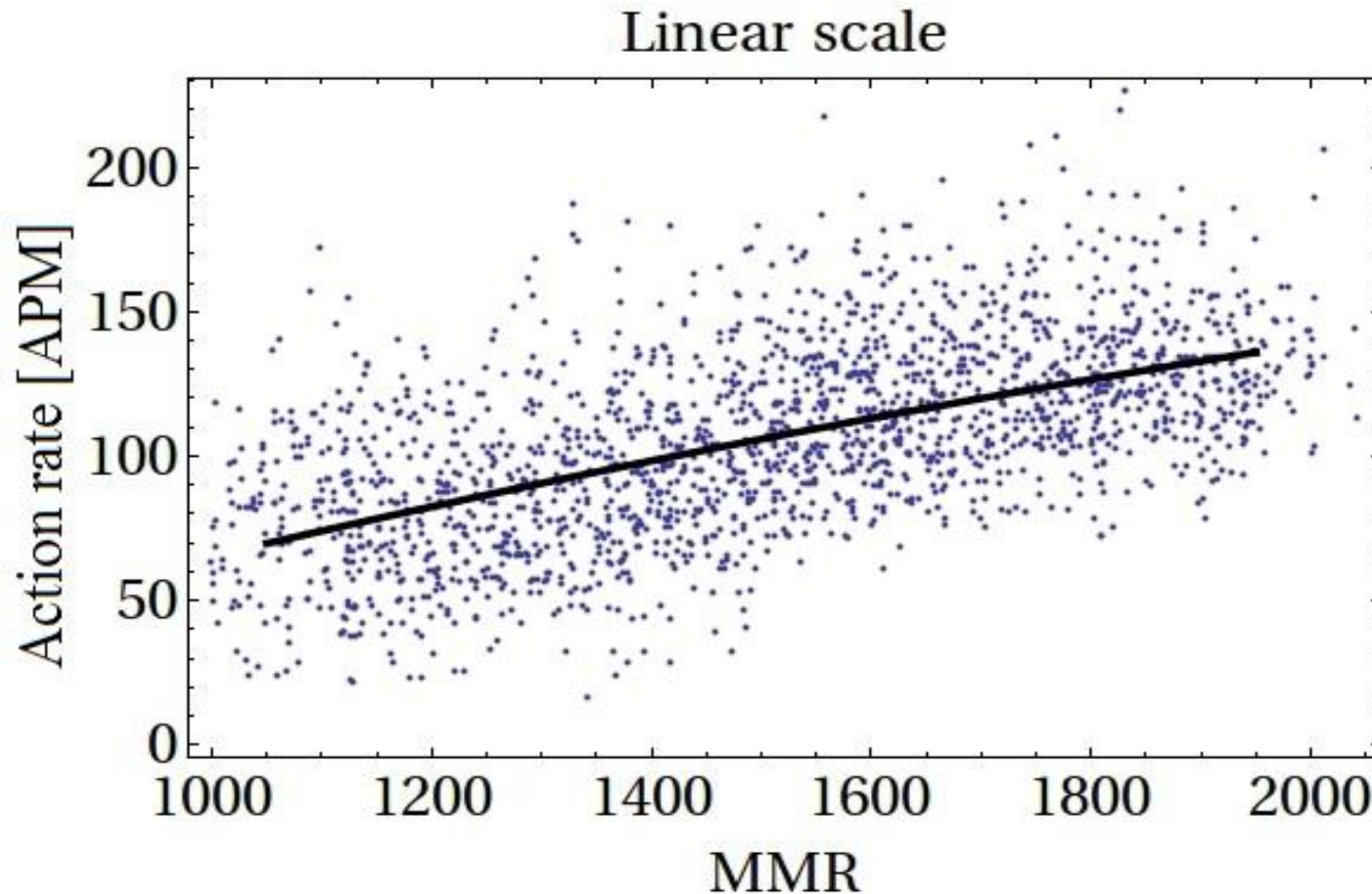


- ◆ Both K/D and A/D ratio positively correlated with MMR
- ◆ *Smurfs* - highly skilled players on low rating

# Gold and Experience per min.

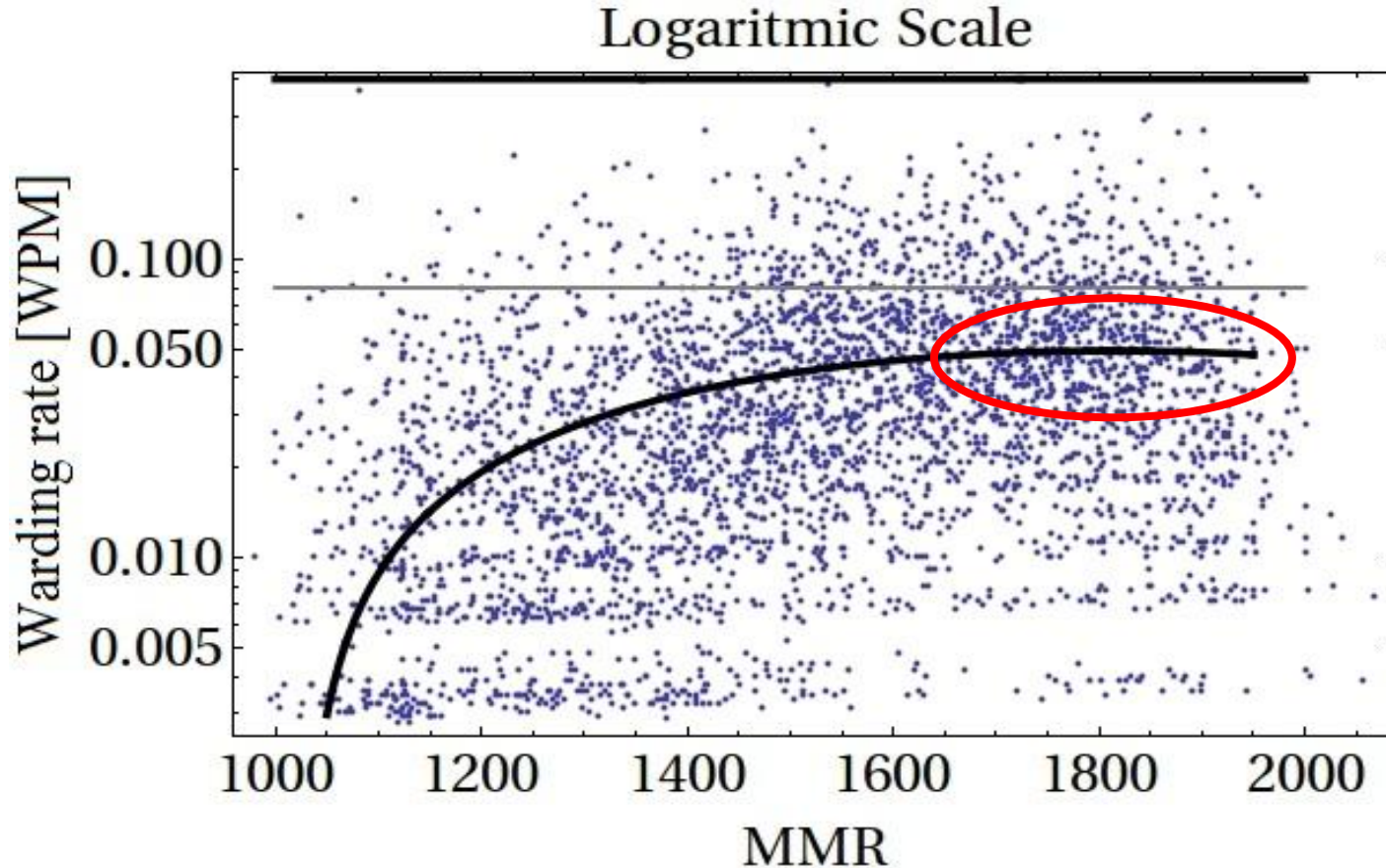


- ◆ Both K/D and A/D ratio positively correlated with MMR
- ◆ Again the high of XPM and GPM on very low rating



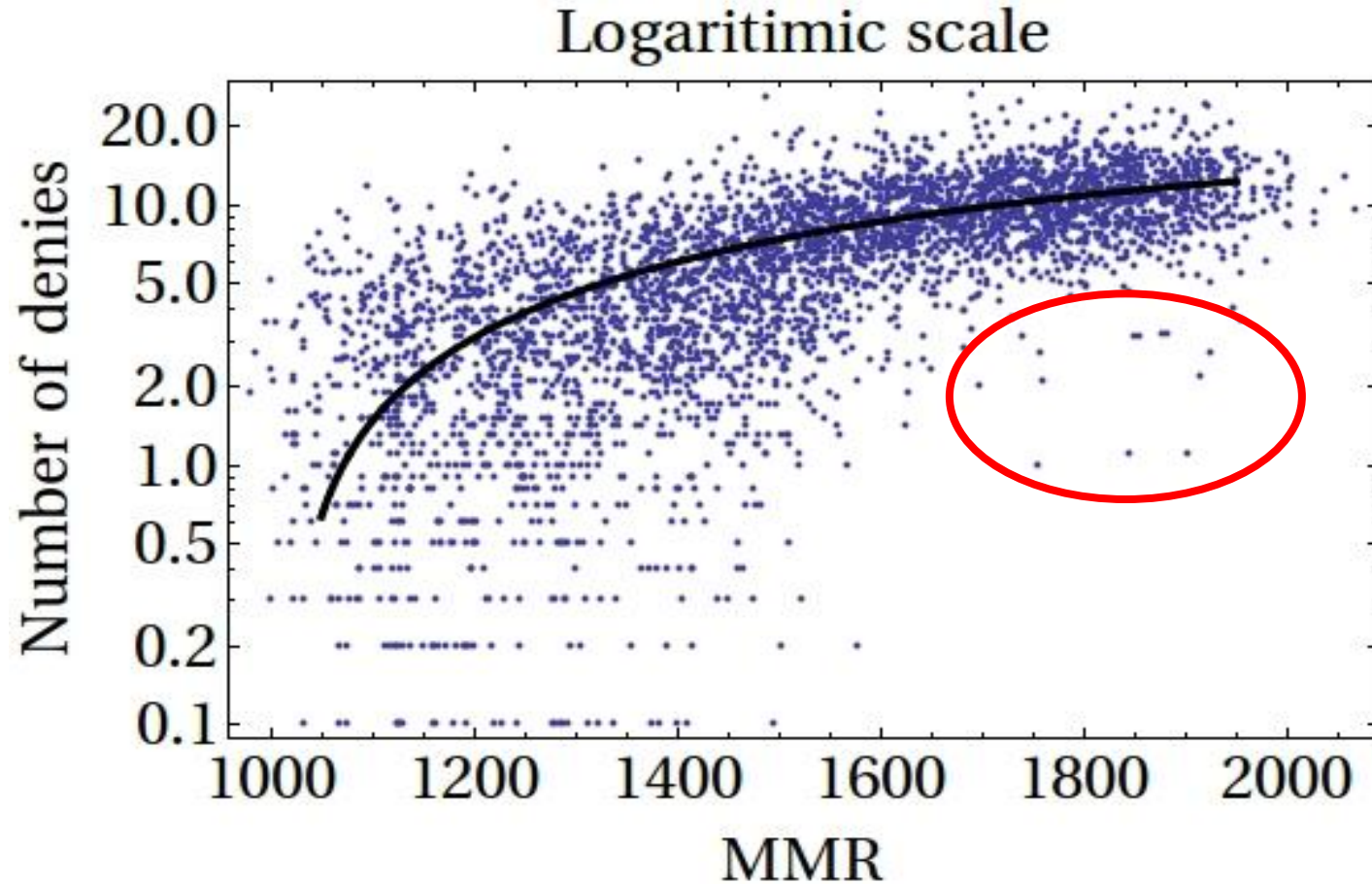
- ◆ Action rate positively correlated with MMR





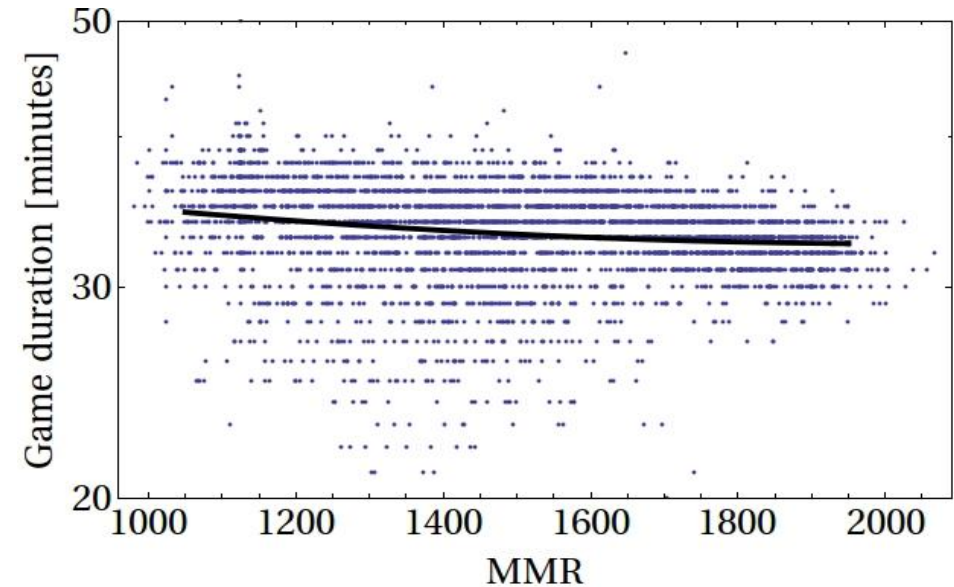
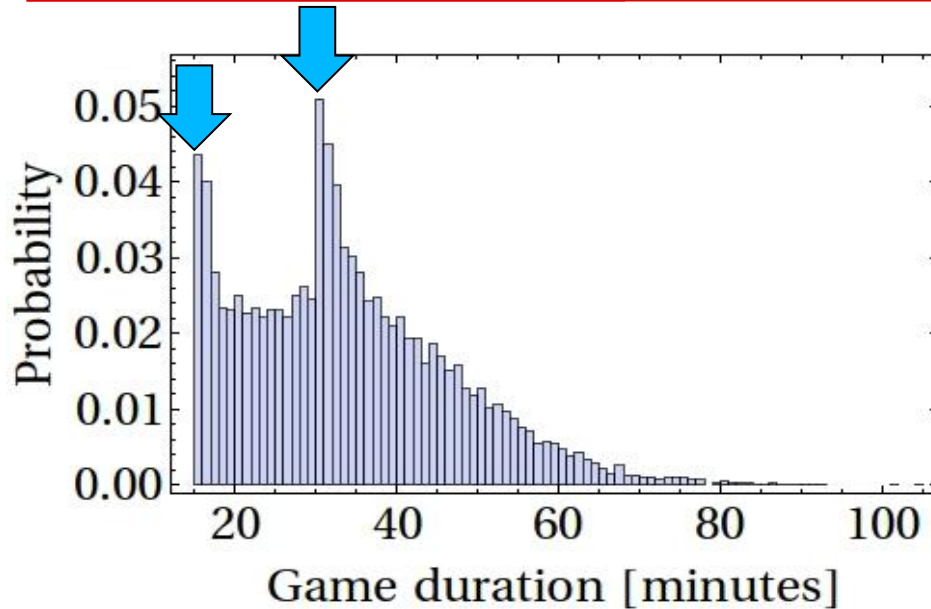
- ◆ Higher rated players ward more
- ◆ Best of the best are an exception

# Number of denials



- ◆ Very indicative metric and very dependant on the rating

# Game duration



- ◆ Game duration spikes
  - 15 minutes first concede mark (5 players conceding)
  - 30 minutes second concede mark (4 players conceding)
- ◆ Games tend to last less as rating increases



- ◆ MMR system does capture player “skill”, however...
  - Some anomalies are observed
  - “Smurfs” are still a problem
  - Algorithm works rather slowly
  - Algorithm’s weakness is taking only the outcome of the match as input
  
- ◆ Possible future work
  - Player behaviour patterns
  - Identification of unbalances between heroes using statistical approaches
  - Design of role based rating system
  - Improvements of matchmaking system