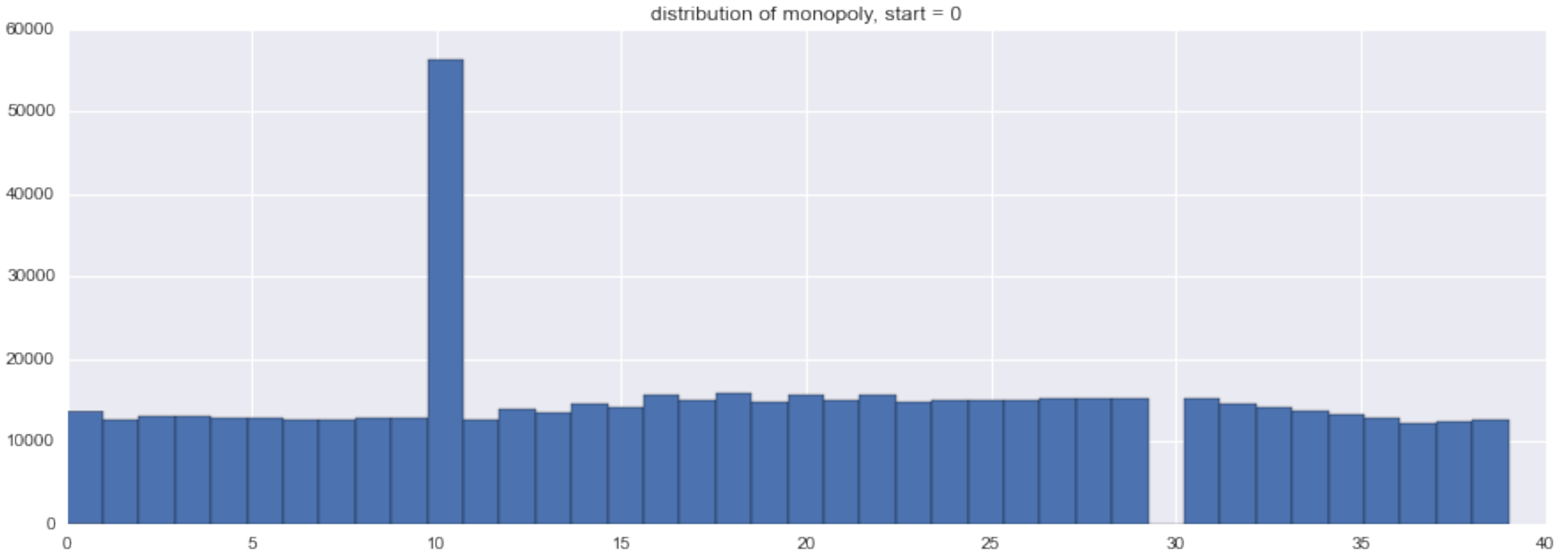
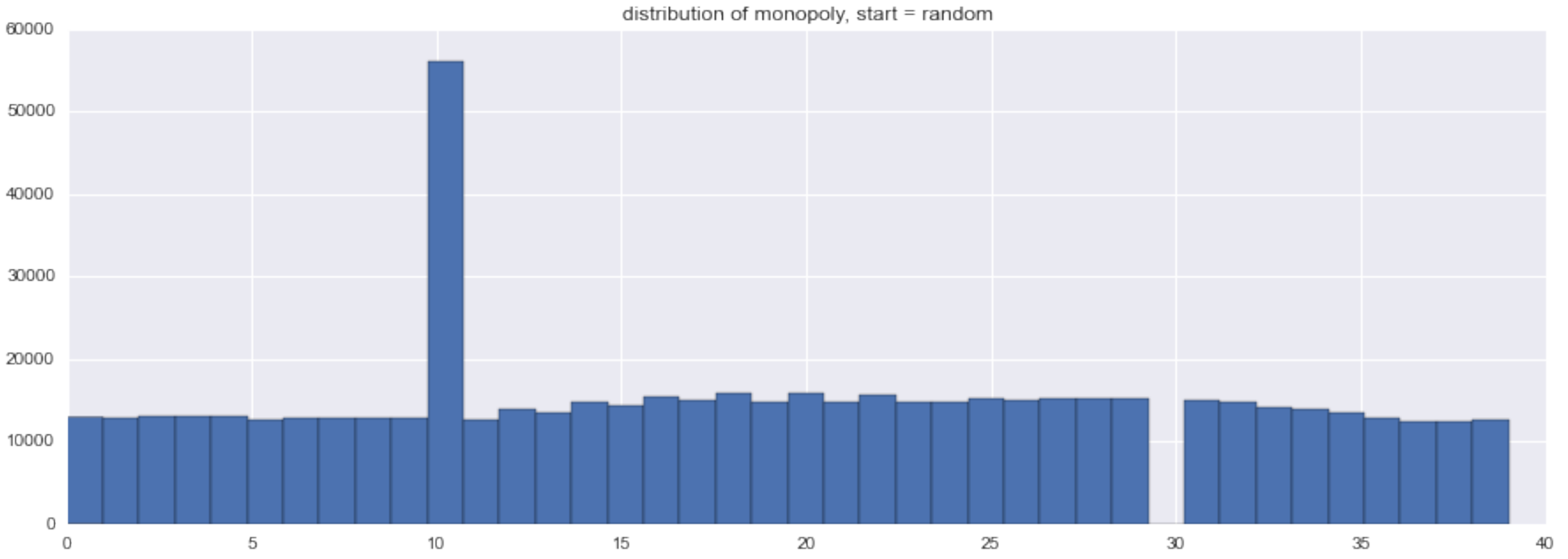
Joy of Data

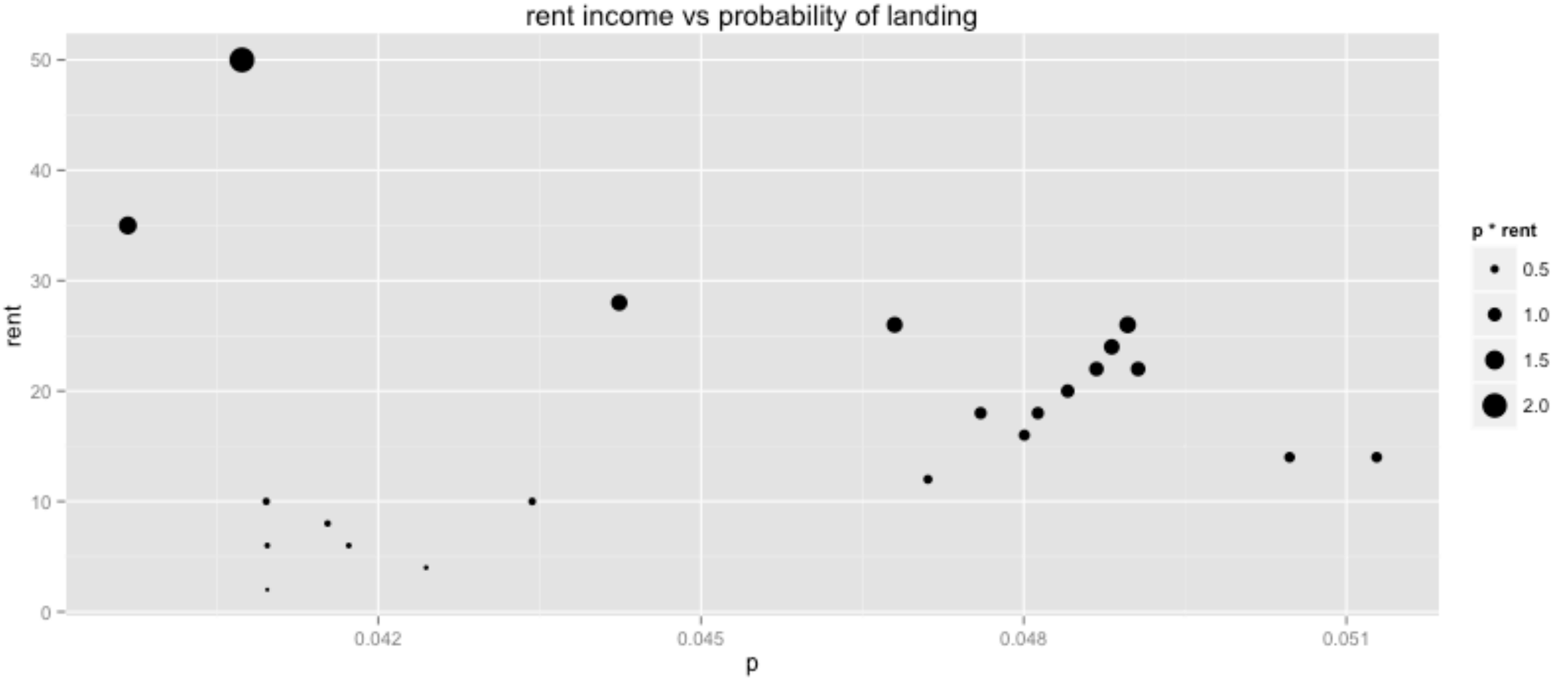
Get better at (video) games

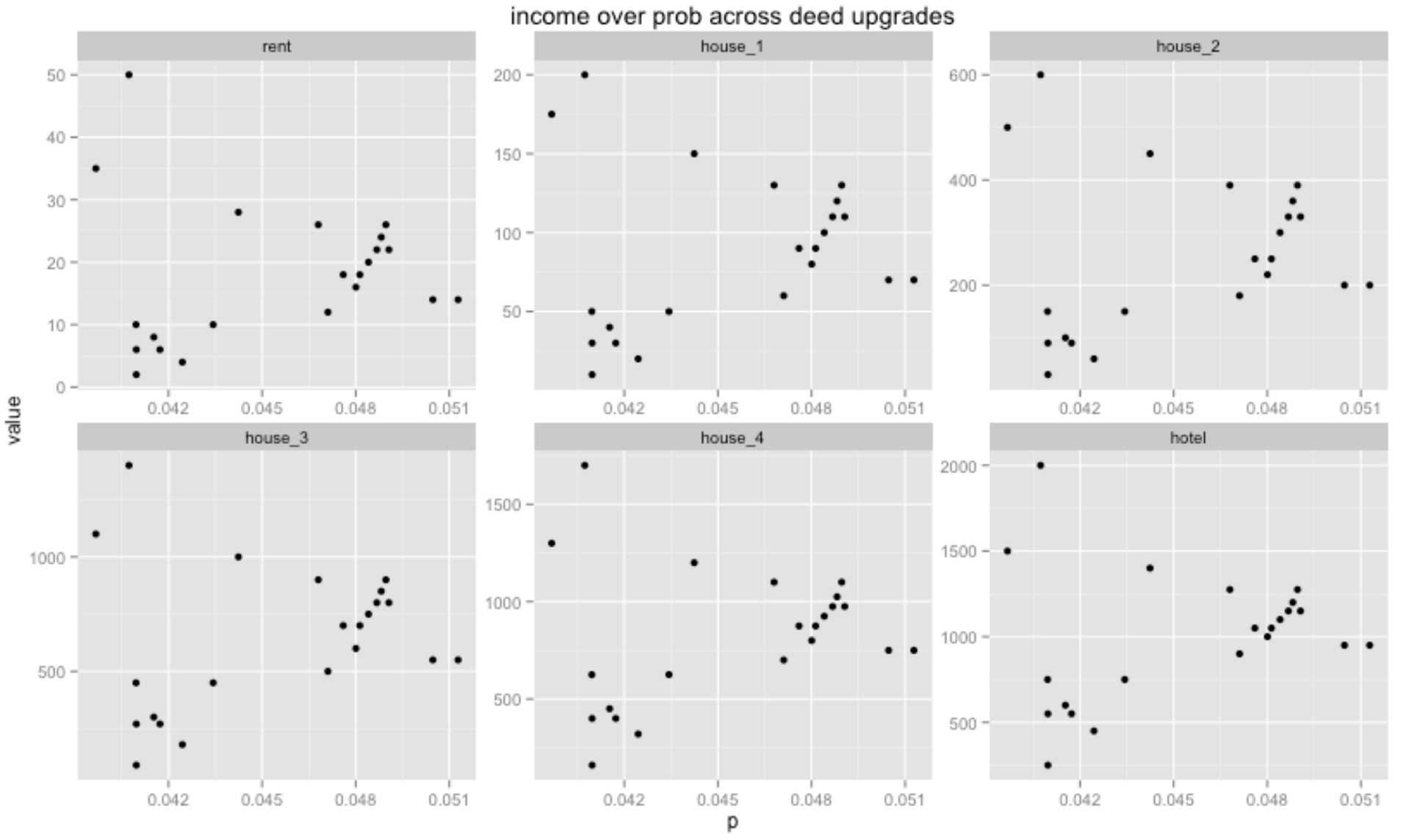
Monopoly

MONOPOLY
COMMUNITY CHEST
CHANCE
GO
COLLECT $200.00 SALARY AS YOU PASS
MEDITER-RANEAN AVENUE
PRICE $60
COMMUNITY CHEST
FOLLOW INSTRUCTIONS ON TOP CARD
BALTIC AVENUE
PRICE $80
INCOME TAX
PAY 10% OR $200
READING RAILROAD
PRICE $200
ORIENTAL AVENUE
PRICE $100
CHANCE
VERMONT AVENUE
PRICE $100
CONNECTICUT AVENUE
PRICE $120
JUST VISITING
IN JAIL
ST. CHARLES PLACE
PRICE $140
ELECTRIC COMPANY
PRICE $150
STATES AVENUE
PRICE $140
VIRGINIA AVENUE
PRICE $160
PENNSYLVANIA RAILROAD
PRICE $200
ST. JAMES PLACE
PRICE $120
COMMUNITY CHEST
FOLLOW INSTRUCTIONS ON TOP CARD
TENNESSEE AVENUE
PRICE $120
NEW YORK AVENUE
PRICE $120
FREE PARKING
KENTUCKY AVENUE
PRICE $120
CHANCE
INDIANA AVENUE
PRICE $120
ILLINOIS AVENUE
PRICE $120
B&O RAILROAD
PRICE $200
ATLANTIC AVENUE
PRICE $260
VENTNOR AVENUE
PRICE $260
WATER WORKS
PRICE $150
MARVIN GARDENS
PRICE $280
GO TO JAIL
PACIFIC AVENUE
PRICE $300
NORTH CAROLINA AVENUE
PRICE $300
COMMUNITY CHEST
FOLLOW INSTRUCTIONS ON TOP CARD
PENNSYLVANIA AVENUE
PRICE $320
SHORT LINE
PRICE $200
CHANCE
PARK PLACE
PRICE $350
LUXURY TAX
PAY $75.00
BOARDWALK
PRICE $400

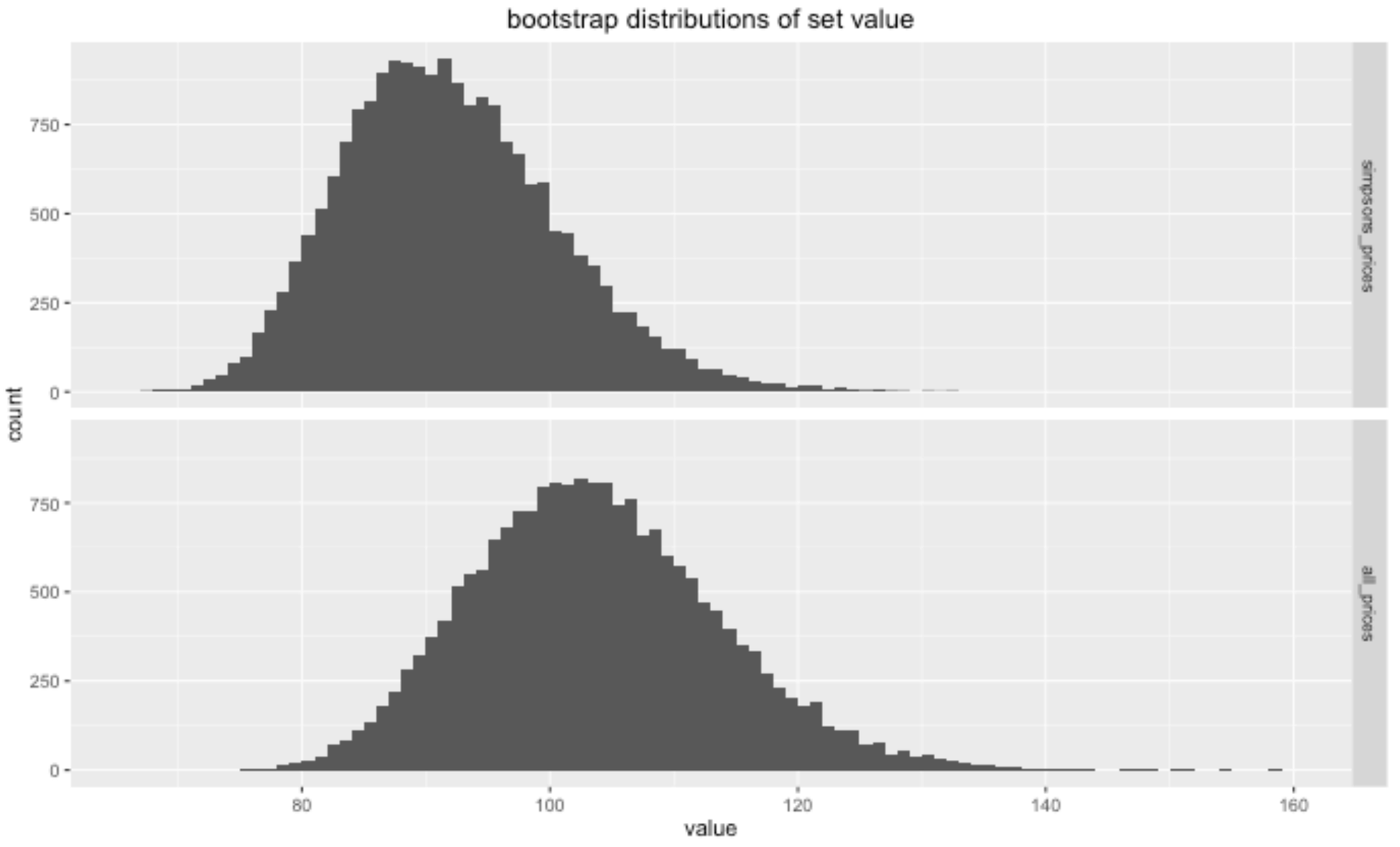

distribution of monopoly, start = 0
60000
50000
40000
30000
20000
10000
0
0
5
10
15
20
25
30
35
40


distribution of monopoly, start = random
60000
50000
40000
30000
20000
10000
0
0
5
10
15
20
25
30
35
40


rent income vs probability of landing
rent
50
40
30
20
10
0
0.042
0.045
0.048
0.051
p
p * rent
0.5
1.0
1.5
2.0


income over prob across deed upgrades
rent
house_1
house_2
house_3
house_4
hotel
value
p
0.042
0.045
0.048
0.051

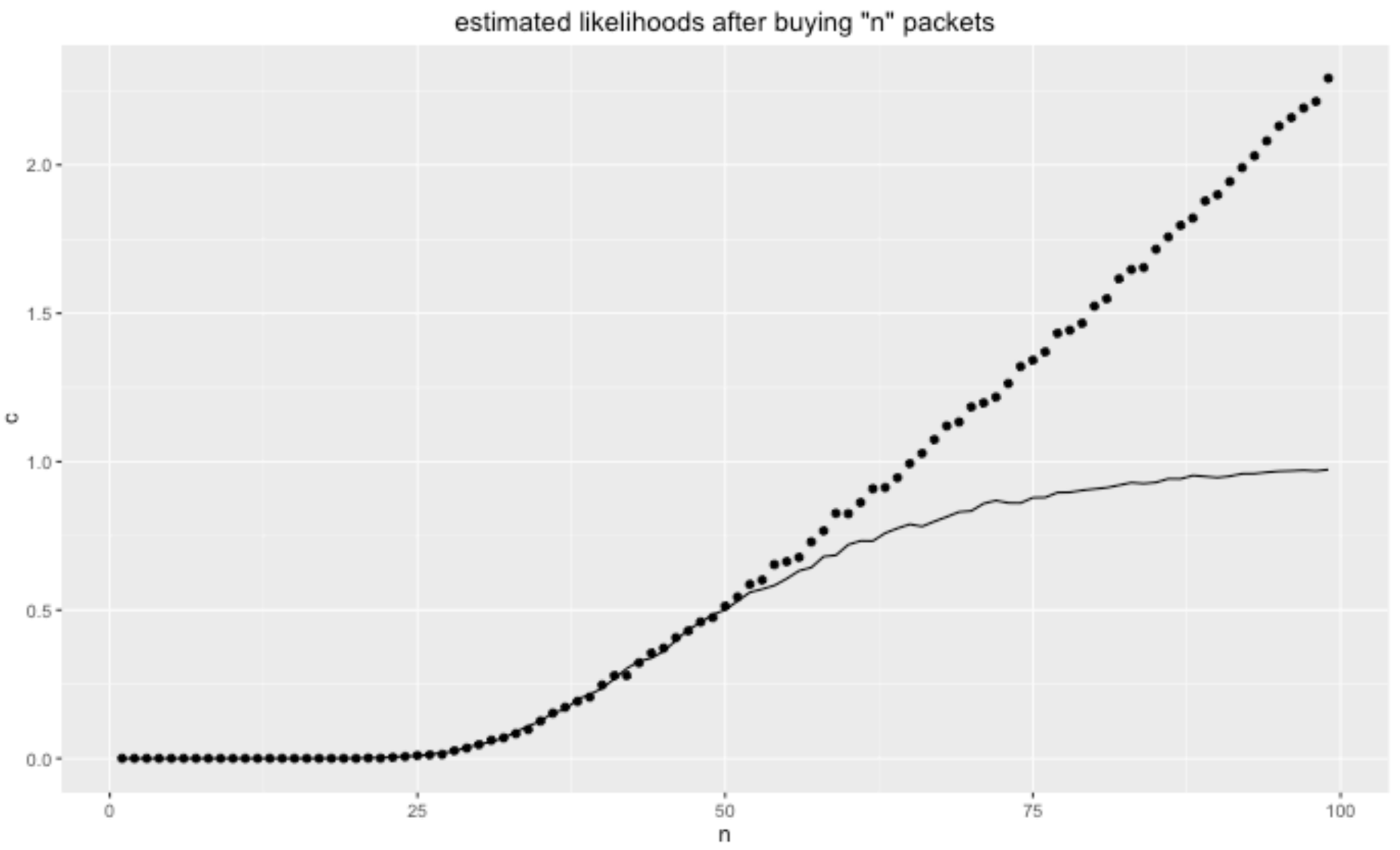
Lego Minifigures

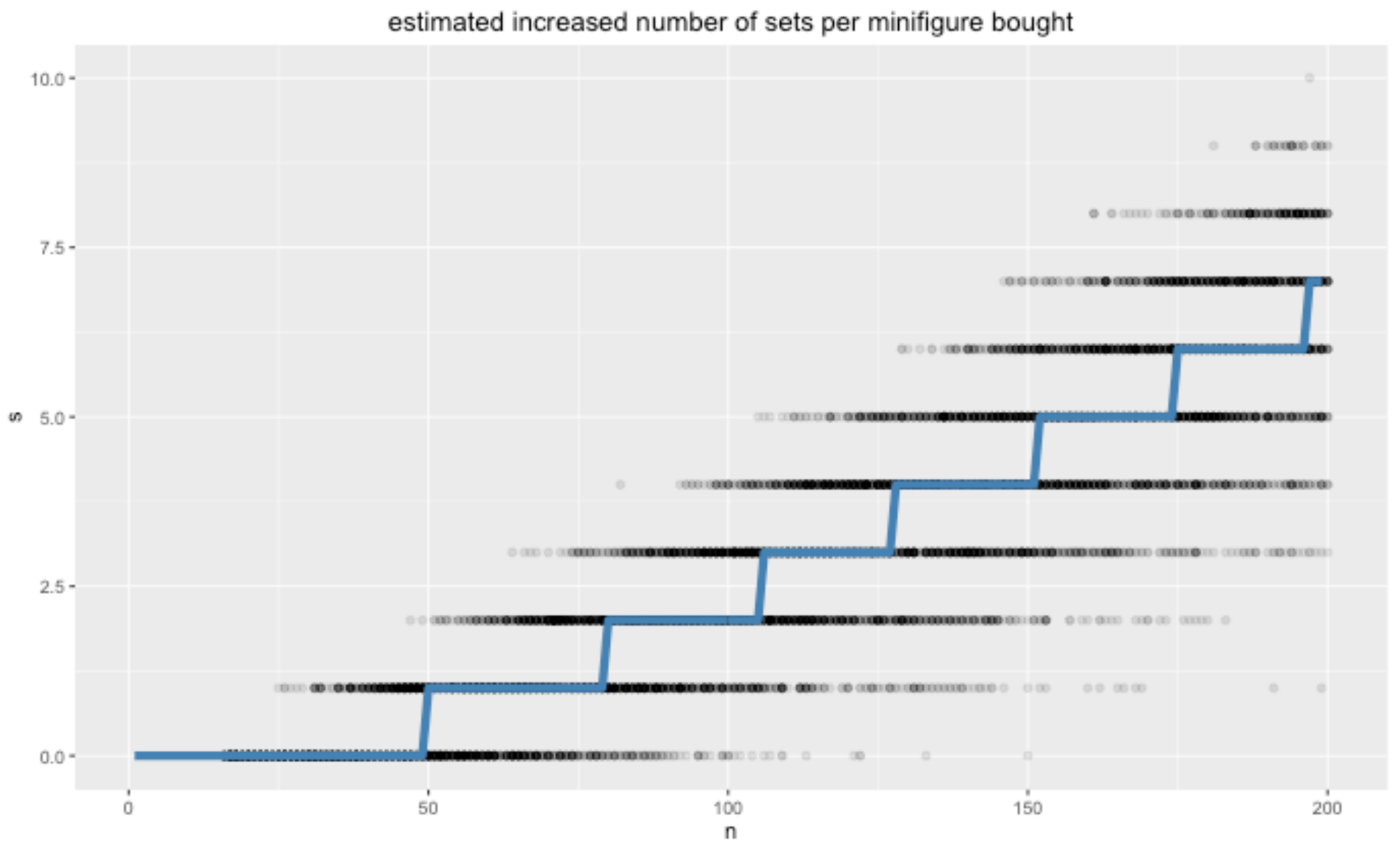

bootstrap distributions of set value
count
750
500
250
0
simpsons_prices
all_prices
80
100
120
140
160
value

```
cores <- detectCores() # 8 cores on my machine
k <- 16
new_row <- function(n){
  s <- 3000
  p <- 1:s %>%
    map_dbl(~sample(1:k, n, replace = TRUE) %>% unique %>% length) %>%
    map_dbl(~. == 16) %>%
    sum
  c <- 1:s %>%
    map_dbl(~sample(1:k, n, replace = TRUE) %>%
              factor(levels=as.character(1:16)) %>%
              table %>% min) %>%
    mean
  data.frame(n = n, p = p/s, c = c)
}

res <- mclapply(1:800, new_row, mc.cores = cores)

df <- res %>% reduce(rbind)
```

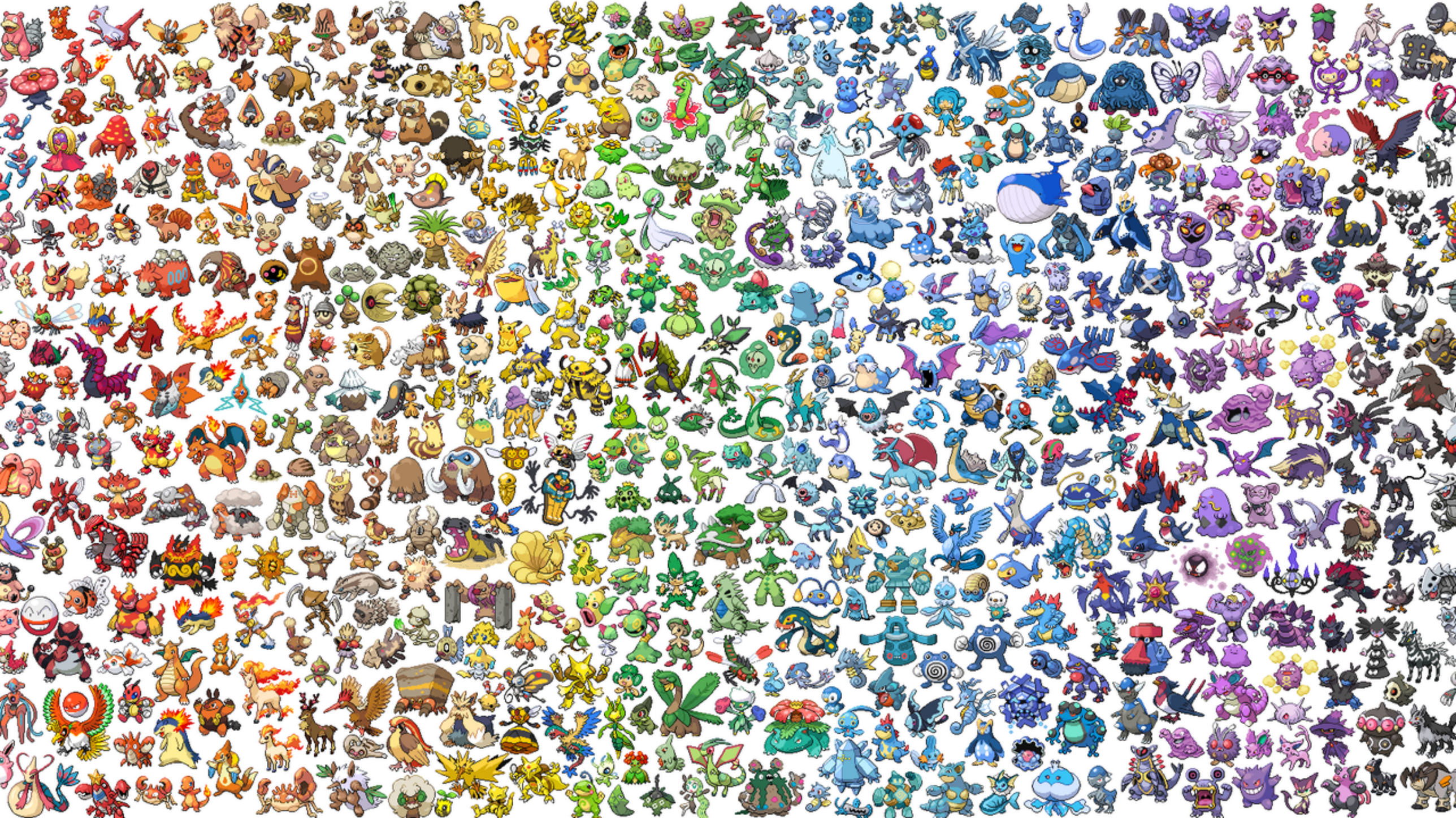

estimated likelihoods after buying "n" packets
c
2.0
1.5
1.0
0.5
0.0
0
25
50
75
100
n


estimated increased number of sets per minifigure bought
10.0
7.5
5.0
2.5
0.0
s
0
50
100
150
200
n

StarCraft

(online demo)

Pokemon



Pokemon: Red/Blue

Pokemon Science

Classic Nintendo Games are (Computationally) Hard

Greg Aloupis* Erik D. Demaine† Alan Guo†‡ Giovanni Viglietta§

February 10, 2015

Abstract

We prove NP-hardness results for five of Nintendo's largest video game franchises: Mario, Donkey Kong, Legend of Zelda, Metroid, and Pokémon. Our results apply to generalized versions of Super Mario Bros. 1–3, The Lost Levels, and Super Mario World; Donkey Kong Country 1–3; all Legend of Zelda games; all Metroid games; and all Pokémon role-playing games. In addition, we prove PSPACE-completeness of the Donkey Kong Country games and several Legend of Zelda games.

1 Introduction

A series of recent papers have analyzed the computational complexity of playing many different video games [1, 4, 5, 6], but the most well-known classic Nintendo games have yet to be included among these results. In this paper, we analyze some of the best-known Nintendo games of all time: Mario, Donkey Kong, Legend of Zelda, Metroid, and Pokémon. We prove that it is NP-hard, and in some cases PSPACE-hard, to play generalized versions of most games in these series. In particular, our NP-hardness results apply to the NES games Super Mario Bros. 1–3, Super Mario

Pokemon: Theory

Searching fan websites gave me formulas.

$$T_{ij} = \frac{HP_i}{DMG_{ji}}$$

$$DMG_{ji} = \frac{2L_j + 10}{250} \times \frac{A_j}{D_i} \times w_{ji}$$

Pokemon: Data

Searching fan websites gave me data.

Pokéapi - The Pokémon RESTful API

Finally; all the Pokémon data you'll ever need, in one place,
and easily accessible through a modern RESTful API.

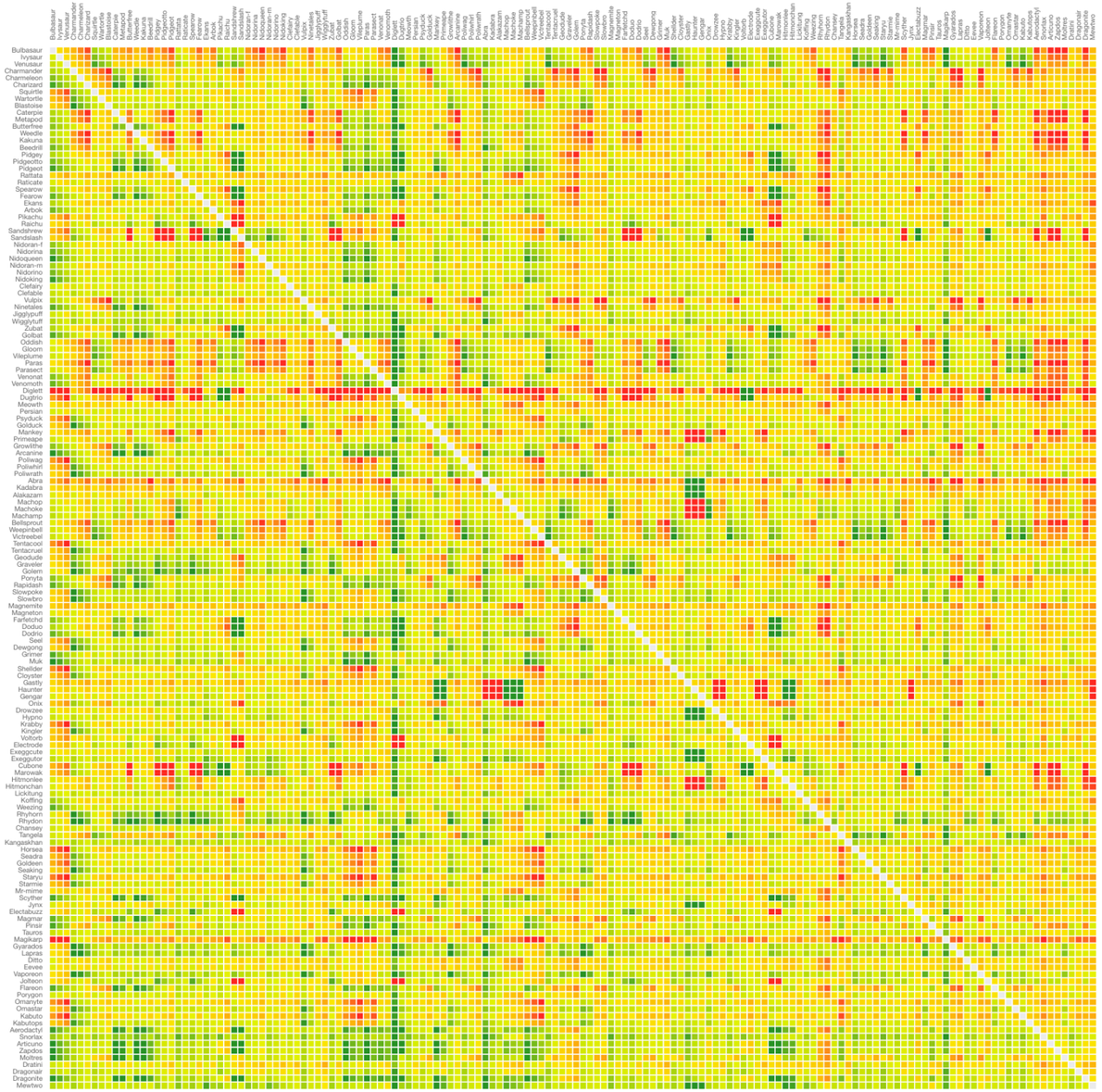
Over **37,503,000** API calls received!

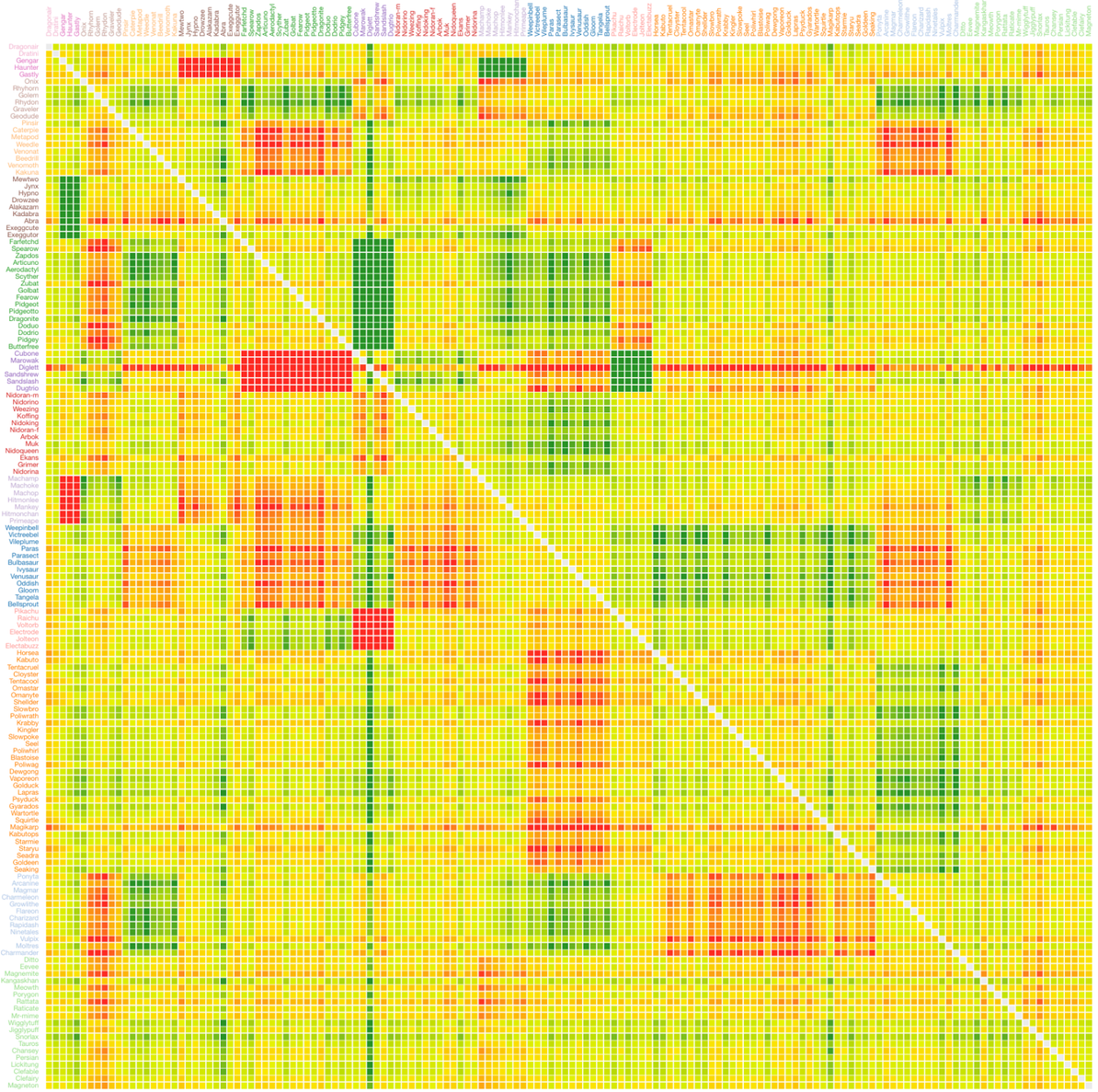
Try it now!

http://pokeapi.co/api/v1/ | pokemon/1/ | submit

Need a hint? try *pokemon/1/* or *type/3/* or *ability/4/*

Resource for Bulbasaur


Bulbasaur
Ivysaur
Venusaur
Charmander
Charmeleon
Charizard
Squirtle
Wartortle
Blastoise
Caterpie
Metapod
Butterfree
Weedle
Kakuna
Beedrill
Pidgey
Pidgeotto
Pidgeot
Rattata
Raticate
Spearow
Fearow
Ekans
Arbok
Pikachu
Raichu
Sandshrew
Sandslash
Nidoran-f
Nidorina
Nidoqueen
Nidoran-m
Nidorino
Nidoking
Clefairy
Clefable
Vulpix
Ninetales
Jigglypuff
Wigglytuff
Zubat
Golbat
Oddish
Gloom
Vileplume
Paras
Parasect
Venonat
Venomoth
Diglett
Dugtrio
Meowth
Persian
Psyduck
Golduck
Mankey
Primeape
Growlithe
Arcanine
Poliwag
Poliwhirl
Poliwrath
Abra
Kadabra
Alakazam
Machop
Machoke
Machamp
Bellsprout
Weepinbell
Victreebel
Tentacool
Tentacruel
Geodude
Graveler
Golem
Ponyta
Rapidash
Slowpoke
Slowbro
Magnemite
Magneton
Farfetch'd
Doduo
Dodrio
Seel
Dewgong
Grimer
Muk
Shellder
Cloyster
Gastly
Haunter
Gengar
Onix
Drowzee
Hypno
Krabby
Kingler
Voltorb
Electrode
Exeggcute
Exeggutor
Cubone
Marowak
Hitmonlee
Hitmonchan
Lickitung
Koffing
Weezing
Rhyhorn
Rhydon
Chansey
Tangela
Kangaskhan
Horsea
Seadra
Goldeen
Seaking
Staryu
Starmie
Mr-mime
Scyther
Jynx
Electabuzz
Magmar
Pinsir
Tauros
Magikarp
Gyarados
Lapras
Ditto
Eevee
Vaporeon
Jolteon
Flareon
Porygon
Omanyte
Omastar
Kabuto
Kabutops
Aerodactyl
Snorlax
Articuno
Zapdos
Moltres
Dratini
Dragonair
Dragonite
Mewtwo

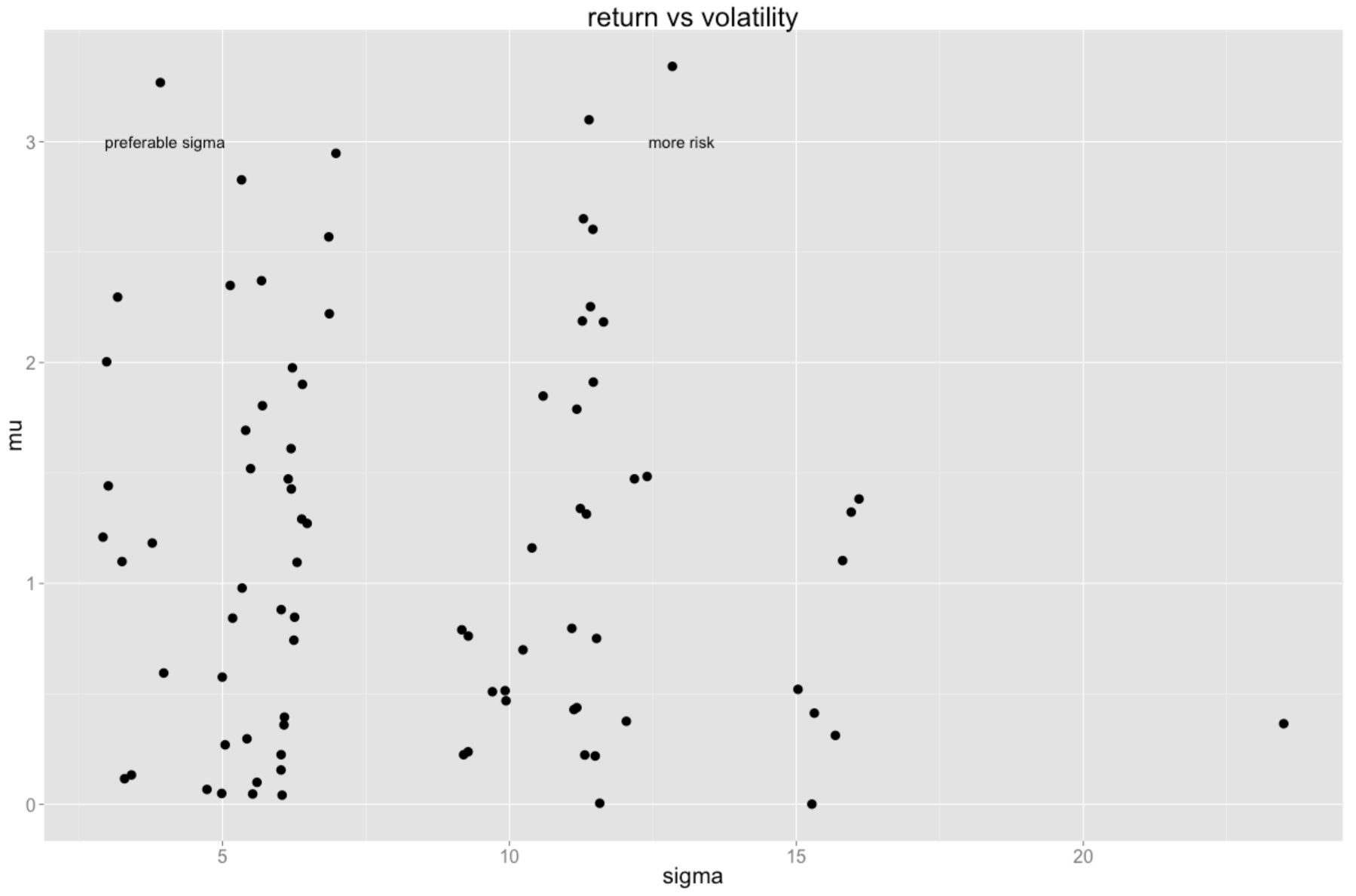

Dragonair
Dratini
Gengar
Haunter
Gastly
Onix
Rhyhorn
Golem
Rhydon
Graveler
Geodude
Pinsir
Caterpie
Metapod
Weedle
Venonat
Beedrill
Venomoth
Kakuna
Mewtwo
Jynx
Hypno
Drowzee
Alakazam
Kadabra
Abra
Exeggcute
Exeggutor
Farfetchd
Spearow
Zapdos
Articuno
Aerodactyl
Scyther
Zubat
Golbat
Fearow
Pidgeot
Pidgeotto
Dragonite
Doduo
Dodrio
Pidgey
Butterfree
Cubone
Marowak
Diglett
Sandshrew
Sandslash
Dugtrio
Nidoran-m
Nidorino
Weezing
Koffing
Nidoking
Nidoran-f
Arbok
Muk
Nidoqueen
Ekans
Grimer
Nidorina
Machamp
Machoke
Machop
Hitmonlee
Mankey
Hitmonchan
Primeape
Weepinbell
Victreebel
Vileplume
Paras
Parasect
Bulbasaur
Ivysaur
Venusaur
Oddish
Gloom
Tangela
Bellsprout
Pikachu
Raichu
Voltorb
Electrode
Jolteon
Electabuzz
Horsea
Kabuto
Tentacruel
Cloyster
Tentacool
Omastar
Omanyte
Shellder
Slowbro
Poliwrath
Krabby
Kingler
Slowpoke
Seel
Poliwhirl
Blastoise
Poliwag
Dewgong
Vaporeon
Golduck
Lapras
Psyduck
Gyarados
Wartortle
Squirtle
Magikarp
Kabutops
Starmie
Staryu
Seadra
Goldeen
Seaking
Ponyta
Arcanine
Magmar
Charmeleon
Growlithe
Flareon
Charizard
Rapidash
Ninetales
Vulpix
Moltres
Charmander
Ditto
Eevee
Magnemite
Kangaskhan
Meowth
Porygon
Raffata
Raticate
Mr-mime
Wigglytuff
Jigglypuff
Snorlax
Tauros
Chansey
Persian
Lickitung
Clefable
Clefairy
Magneton

A bit of financial maths

Here μ_i is the expected 'win' and σ is the risk of losing.

$$\mu_i = \frac{\sum_{j=1}^{N} T_{ij}}{N}$$

$$\sigma_i = \sqrt{\frac{\sum_{j=1}^{N} (T_{ij} - \mu_i)^2}{N-1}}$$


return vs volatility
preferable sigma
more risk
mu
sigma
0
1
2
3
5
10
15
20

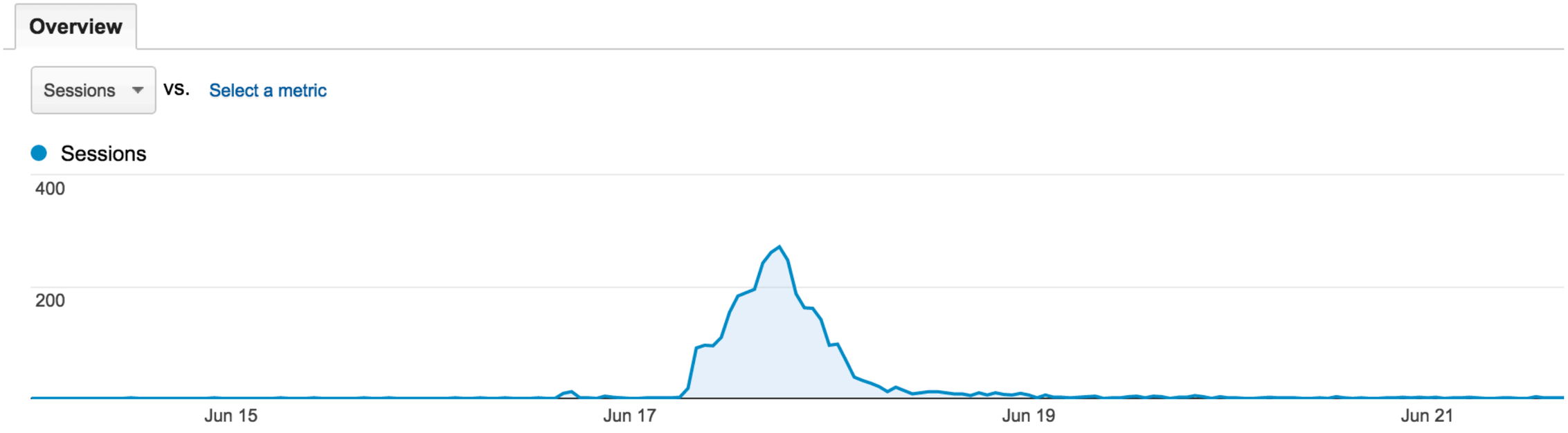
Good portfolio of pokemon

```
                mu    sigma

Wigglytuff 2.296484 3.173598
Snorla   3.267974 3.917765
Exeggutor  2.349300 5.135687
Mewtwo     2.827446 5.332813
Muk        2.370720 5.680507
```

And then this happend ...

Guess when the post was written



/r/pokemon/

reddit

/r/pokemon/

Feedback:

- pokemon fans did **not** agree with my modelling methods

/r/pokemon/

Feedback:

- pokemon fans did **not** agree with my modelling methods
- pokemon fans did agree that my models output made sense

/r/pokemon/

Feedback:

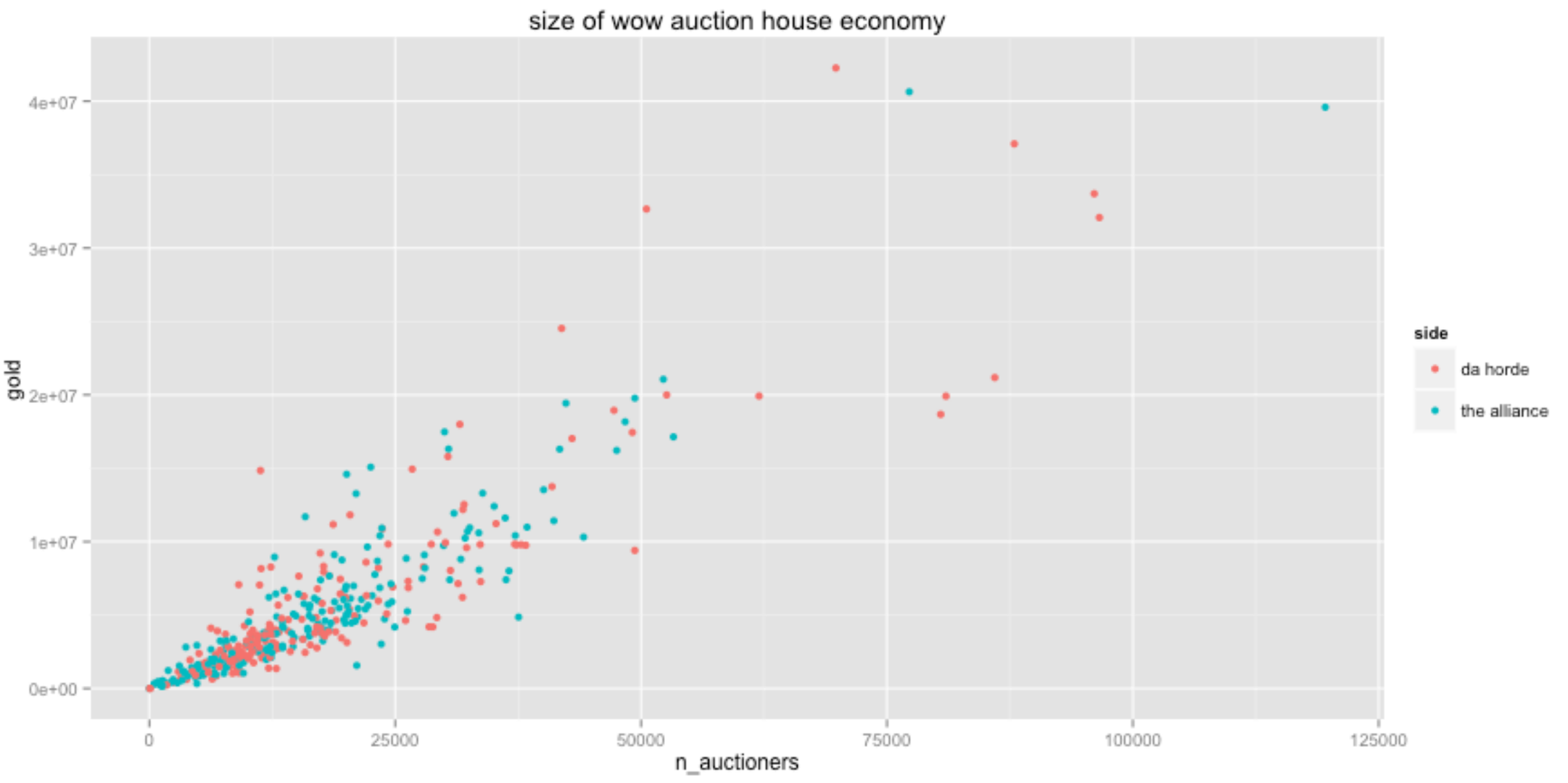
- pokemon fans did **not** agree with my modelling methods
- pokemon fans did agree that my models output made sense

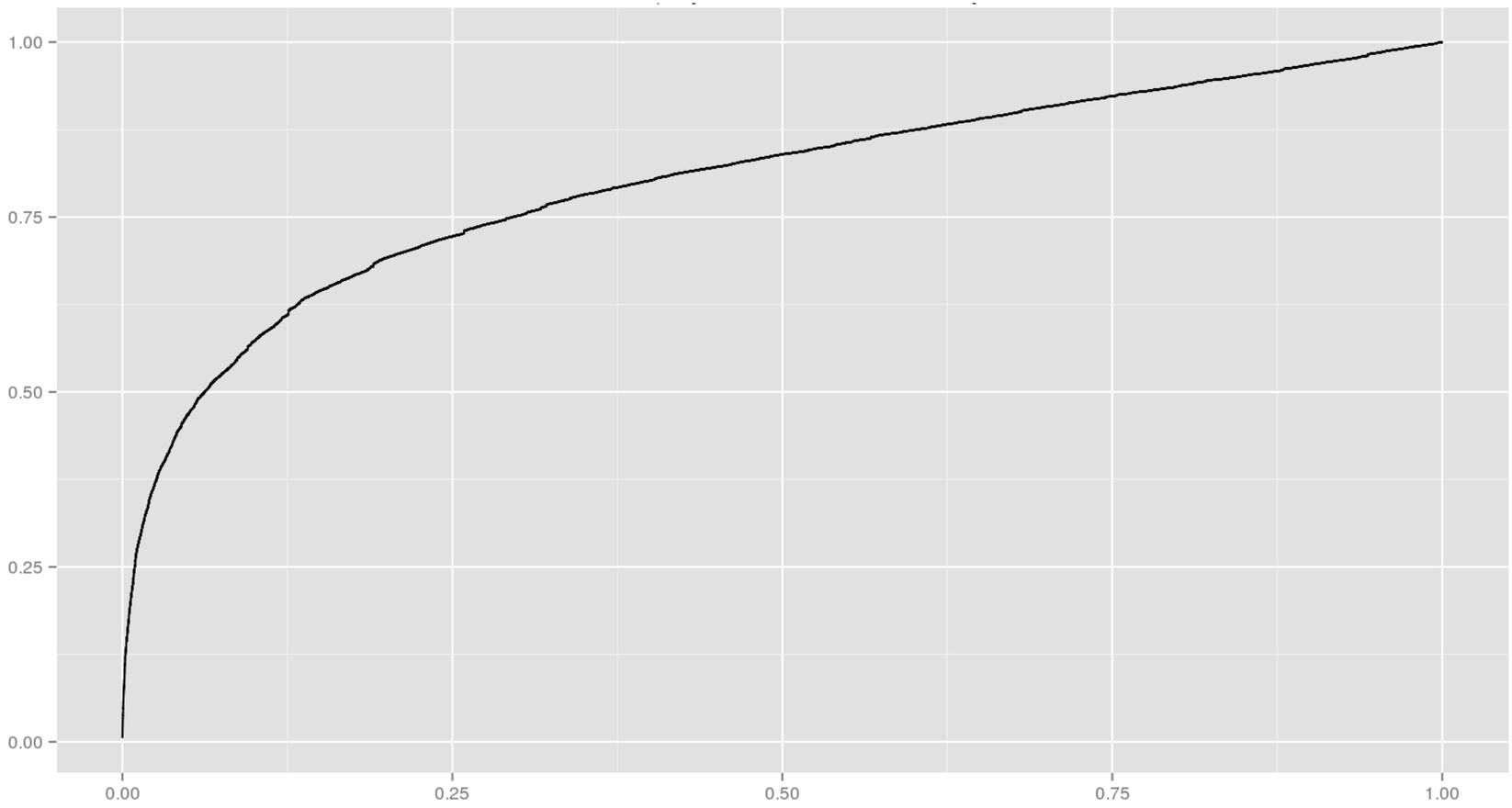
Why this matters:

- pokemon is relatively complicated
- a good tactic without any domain knowledge
- data made me better with relatively little effort

World of Warcraft

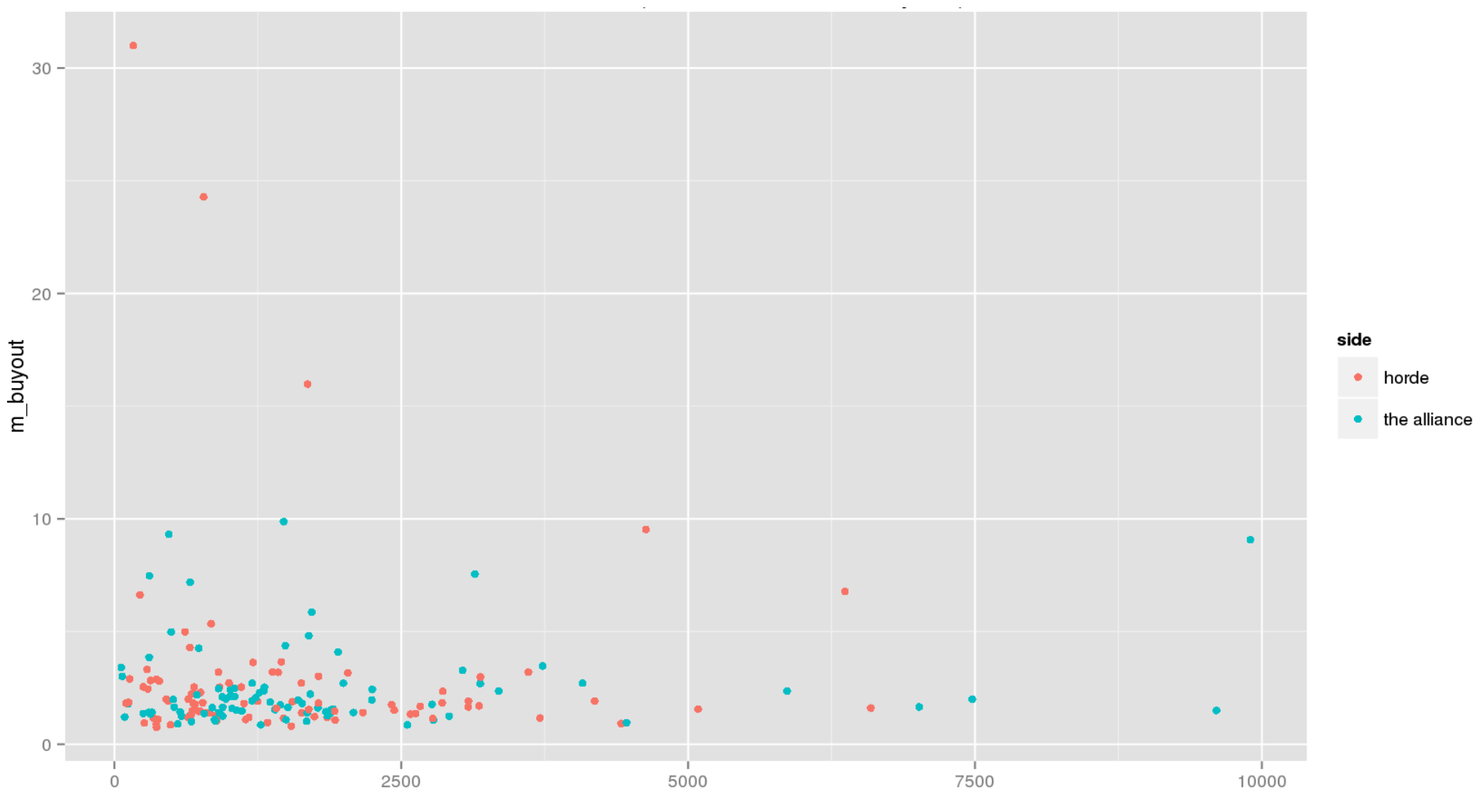
Browse Auctions
Name
kingsblood
Level Range
Rarity
Usable Items
Search
Display on Character
Filters
Weapon
Armor
Container
Consumable
Trade Goods
Projectile
Quiver
Recipe
Reagent
Miscellaneous
Rarity
Lvl
Time Left
Seller
Current Bid
Kingsblood 1 Very Long Eluma Buyout 8 8 10 10
Kingsblood 1 Very Long Bobdobbs Buyout 9 0 11 25
Kingsblood 1 Very Long Direwolves Buyout 8 45 11 33
Kingsblood 1 Very Long Pokenyou Buyout 9 37 25 0
Kingsblood 1 Very Long Bobdobbs Buyout 9 0 11 25
Kingsblood 1 Very Long Riftt Buyout 4 68 6 15
Kingsblood 1 Very Long Direwolves Buyout 4 70 5 31
Kingsblood 1 Long Paulairine Buyout 4 0 6 0
2 0 85
Bid 60 85
Bid
Buyout
Close
Browse
Bids
Auctions


size of wow auction house economy
gold
4e+07
3e+07
2e+07
1e+07
0e+00
0
25000
50000
75000
100000
125000
n_auctioners
side
da horde
the alliance


1.00
0.75
0.50
0.25
0.00
0.00
0.25
0.50
0.75
1.00

Browse Auctions
Name
kingsblood
Level Range
Rarity
Usable Items
Search
Display on Character
Filters
Weapon
Armor
Container
Consumable
Trade Goods
Projectile
Quiver
Recipe
Reagent
Miscellaneous
Rarity
Lvl
Time Left
Seller
Current Bid
Kingsblood 1 Very Long Eluma Buyout 8 8 10 10
Kingsblood 1 Very Long Bobdobbs Buyout 9 0 11 25
Kingsblood 1 Very Long Direwolves Buyout 8 45 11 33
Kingsblood 1 Very Long Pokenyou Buyout 9 37 25 0
Kingsblood 1 Very Long Bobdobbs Buyout 9 0 11 25
Kingsblood 1 Very Long Riftt Buyout 4 68 6 15
Kingsblood 1 Very Long Direwolves Buyout 4 70 5 31
Kingsblood 1 Long Paulairine Buyout 4 0 6 0
2 0 85
Bid 60 85
Bid
Buyout
Close
Browse
Bids
Auctions

Market size vs price[1]



[1] for spirit dust we check for every server what the market quantity is and the mean buyout