Clash Royale Balance Equation

I've elaborated on the full thought process in my previous reports so I'll just summarize it here:

- Use the tournament card levels.
- Analyze damage spells separately (results were presented in the first installment).
- Start with only the basic cards:
  - barbarians
  - knight
  - musketeer
  - valkyrie
  - spear goblins
  - goblins
  - archers
  - skeletons
  - bomber
  - mini pekka
  - wizard
  - pekka
  - skeleton army
- Use least square optimization algorithms to find the coefficients for HP, DPS, range, area damage and penalty for high count. I wrote several Matlab scripts to do that.
- Include Minions, Minion Horde and Baby Dragon to get the coefficient for flying - using the same algorithm.
- Include the rest of the cards and calculate their value according to the formula.
- Use the charge damage for Prince and Dark Prince DPS calculation.
- Turns out legendary cards get a ~0.5 bonus value.
- Turns out units that target buildings directly have a penalty.

So the final **balance equation** I think is best is:

$$\text{Card Cost} = 0.0010 \times HP + 0.0088 \times DPS - 0.204 \times Count + 0.317 \times range$$
$$\text{Flying} = +0.328$$
$$\text{Area damage} = +1.241$$

Resulting in the following card values:

Troop name	Cost	Calculated Value	Value Difference
minions	3	3.1376	0.1376
minion horde	5	5.4717	0.4717
royal giant	6	5.3685	-0.6315

golem	8	4.6484	-3.3516
giant	5	4.6096	-0.3904
giant skeleton	6	3.2304	-2.7696
barbarians	5	5.4592	0.4592
knight	3	2.3352	-0.6648
musketeer	4	3.704	-0.296
valkyrie	4	3.817	-0.183
spear goblins	2	2.3062	0.3062
goblins	2	2.4294	0.4294
archers	3	2.939	-0.061
skeletons	1	1.6536	0.6536
bomber	3	3.7583	0.7583
three musketeers	9	7.308	-1.692
mini pekka	4	3.6416	-0.3584
wizard	5	4.3992	-0.6008
hog	4	2.8496	-1.1504
prince	5	4.6734	-0.2826
dark prince	4	4.17	-0.027
pekka	7	6.1756	-0.8244
guards	3	1.938	-1.062
sparky	6	5.9515	-0.0485
balloon	5	3.8608	-1.1392
skeleton army	4	3.76	-0.24
baby dragon	4	4.0224	0.0224
goblin barrel	4	2.4294	-1.5706
miner	3	1.9664	-1.0336
Princess	3	4.5108	1.5108
Ice Wizard	3	3.8501	0.8501
Witch	5	3.9118	-1.0882
Lava hound	7	3.8868	-3.1132

Princess does get a lot of extra value from the long range - but the range value should probably not be reduced by much because staple cards like Musketeer and Archers already get negative results.

Until next time,
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