o!m PPv2 bandaid

(You may use this spreadsheet (and the formulae in the sheet) as reference to make it easy for you to understand how the proposed system works. You may also duplicate the spreadsheet for your own personal use.)

You may discuss about the suggestions here.

This is a revision of the PP system that tries (with very emphatic italics on "tries") to amend for certain shortcomings that the current osu!mania PP system has without touching SR. This bandaid is easy to implement, and it primarily amends PP inflation problems and scaling problems. The PP system is still fundamentally flawed because of the SR system (and I will elaborate more on this as to why this is the case later on), but this bandaid makes osu!mania PP marginally better.

tl;dr

- StrainBase modification to reduce exponential rate of growth
- StrainMultiplier modification to reward players more for 700K - 900K scores than what is currently rewarded through the current StrainMultiplier system
- Overhaul of the AccValue system to incentivise players to go for 960K+ scores
- No changes to how the PP value is calculated based on the AccValue, StrainBase, and Strain Multiplier variables (Chesterton's fence applies here, though I suspect that some variables are used for ineffective weighted scaling)
- DT is notably nerfed, players require 80K - 120K (less as score approaches 950K) more to get the same amount of PP in the proposed system compared to the old system. However, DT is still an extremely viable mod to use for players who are competent enough to hit patterns to sustain high accuracies
- **Easily implementable, easily modifiable**
- Still a flawed system because it is a band-aid and because SR and StrainMultiplier are fundamentally flawed principles
- AccValue is a flawed system as well (particularly in how it scales), but amending that is of the lowest priority

Extant problems with the osu!mania PP system:

- The SR system being primarily influenced by short density spikes (it's a bit more complicated than density, but this gets the job done) and patterns that generally do not contribute to difficulty (e.g. very short LNs when surrounded by notes in other columns)
- PP inflation (due to a StrainBase system that gives absurdly high outputs at very high SRs)
- Getting close to 84% of the maximum potential PP from a chart at 800K (due to a poorly constructed StrainMultiplier system)

- AccValue system that does practically nothing at SRs beyond 5

I will only touch on the last 3 problems. It is worth noting that the first problem is the most significant problem because of how StrainBase is calculated through SR, so this bandaid only fixes ~20% of the osu!mania PP system's problems.

Solution

StrainBase

This is the current StrainBase formula:
(5 * max(1, SR / 0.0825) - 4)^3 / 110000 * (1 + 0.1 * min(note count / 1500, 1)

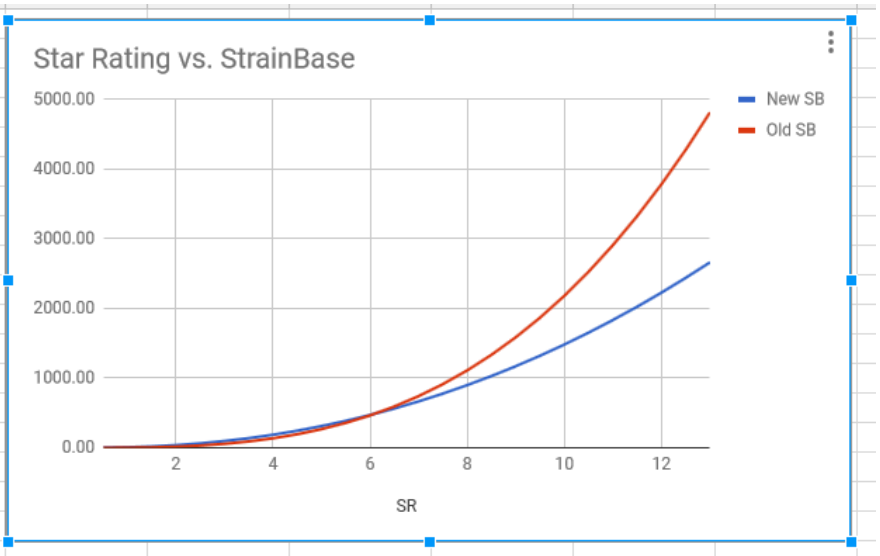
Ignoring the note count component (it is irrelevant for charts beyond 5.5*), an exponent of 3 for StrainBase is far too high. Touching the denominator (110,000) per se does not solve any issues as the denominator cuts StrainBase linearly across all SRs. A linear reduction makes absolutely no sense considering that it doesn't solve the problem of SR giving disproportionately high StrainBase values as SR increases.

This is the proposed StrainBase formula:
(5 * max(1, SR / **0.2**) - 4)^**2.2** / **135** * (1 + 0.1 * min(note count / 1500, 1)

I have amended the SR divisor (the 0.0825 component of the previous formula), the exponent and the denominator to reduce the exponential rate of StrainBase growth. However, the SR divisor and exponent essentially do the same thing; touching the SR divisor affects the base of the exponent, which also affects the rate of StrainBase growth. You can theoretically just modify the exponent and denominator to fix the exponential growth problem that the SB formula had, but I was not entirely sure whether the SR divisor had functions that the exponent did not have at first. I amended the denominator to reduce the linear scaling, for a reduction in exponent (or base) will always reduce in smaller numbers.

With the new formula, you end with StrainBase values of these for an SR range of 0.5 to 13:

SR	New SB	Old SB
0.5	0.90	0.18
1	6.61	1.81
1.5	18.46	6.56
2	37.08	16.10
2.5	62.92	32.10
3	96.34	56.22
3.5	137.65	90.15
4	187.09	135.53
4.5	244.91	194.06
5	311.31	267.39
5.5	386.47	357.20
6	470.58	465.15
6.5	563.80	592.91
7	666.27	742.16
7.5	778.14	914.57
8	899.54	1111.80
8.5	1030.61	1335.52
9	1171.45	1587.40
9.5	1322.18	1869.11
10	1482.91	2182.33
10.5	1653.76	2528.72
11	1834.81	2909.95
11.5	2026.17	3327.69
12	2227.93	3783.61
12.5	2440.17	4279.38
13	2662.99	4816.67



It is worth pointing out that 0.5* to 6* charts have a higher StrainBase in the proposed system (I modified the proposed SB formula to make sure that the SB values between both systems are the same for 6* charts). This is a byproduct of a lower exponent, and I consider this to be a non-issue. It might even be a further incentive for players to play lower difficulty charts (and for newer players in general).

However, a StrainBase alone does not do anything. A StrainMultiplier value is required.

StrainMultiplier

The current SM formula is as follows:
If your score falls under:
~~**0 - 500K points**: 0% + 10% * ((score - 0) / 500,000)~~
500K - 600K points: 0% + 30% * ((score - 500,000) / 100,000)
600K - 700K points: 30% + 35% * ((score - 600,000) / 100,000)
700K - 800K points: 65% + 20% * ((score - 700,000) / 100,000)
800K - 900K points: 85% + 10% * ((score - 800,000) / 100,000)
900K - 1mil points: 95% + 5% * ((score - 900,000) / 100,000)

This means that players have little incentive to go beyond 800K in a chart, for they would get a StrainMultiplier of 85% at 800K. Players already get a StrainMultiplier of 65% at 700K, and 700K

is about the uppermost bound where players are mashing/heavily pattern manipulating (to sustain combo and HP). In typical cases, a 700K score denotes that a player is barely able to hit patterns to ensure a high level of accuracy. A player should not obtaining 65% of StrainBase from just being barely able to hit patterns to ensure a high level of accuracy. It should be lower -- considerably lower. As it is, the system incentivises far too many players go for 600 - 800K scores, even though the conventionally accepted level of competence for an average chart (constant difficulty) is about 850 - 900K.

I propose a SM formula as follows:
If your score falls under:
~~**0 - 500K points**: 0% + 10% * ((score - 0) / 500,000)~~
500K - 600K points: 0% + 30% * ((score - 500,000) / 100,000)
600K - 700K points: 30% + 25% * ((score - 600,000) / 100,000)
700K - 800K points: 55% + 20% * ((score - 700,000) / 100,000)
800K - 900K points: 75% + 15% * ((score - 800,000) / 100,000)
900K - 1mil points: 90% + 10% * ((score - 900,000) / 100,000)

Based on StrainMultiplier alone, players who attain 600K-800K will expect a reduction of 10% of StrainBase compared to the old system. Players will have a higher StrainMultiplier delta as their scores increase from 800K to 1mil compared to the old SM formula as well, which incentivises players to go for 800K to 975K scores. A reduction of 10% might not sound like a lot, but for a 7* chart in the old system, 10% corresponds to 80pp. It corresponds to 120pp for 8* charts and 180pp for 9* charts.

However, using StrainMultiplier values as a proxy for PP% is misleading with the proposed system. This is because **AccValue** has a completely different function in the proposed system, and it contributes a substantial weight to the maximum potential PP for a chart.

AccValue

The current AccValue system works as follows:
150 / OD Window * (Accuracy/100)^16)^1.8 * 2.5 * min(1.15, (Note count / 1500)^0.3)

At the very most, you will be getting an AccValue of **35.22** (100% SS, OD10, 1500+ notes). On a typical run on a typical chart (95 - 98%, OD8, 1500+ notes), you will be getting an AccValue of 6.02 to 14.87. Considering that AccValue and StrainBase * StrainMultiplier is added with no significant weighting that biases towards AccValue, AccValue will only contribute to **0.5% to 3% of the PP that you would get from a typical run**. 0.5% to 3% is practically insignificant, and the AccValue is better off being reconstructed for something better.

Instead, I propose an AccValue system that incentivises players to go for 960K to 1mil scores. Additionally, this AccValue system will be tied to a chart's StrainBase, for it would make sense for scores on harder charts to have a better reward overall.

I propose an AccValue system as follows:
(OD Value / 10) * 0.2 * StrainBase * ((min(Score, 960,000) - 960,000) / 40,000)^1.1

In essence, the AccValue system does this:
1. Checks if your score is above 960,000 (min function)
2. If your score is above 960,000, the system calculates the difference between your score and 960,000 and divides that difference by 40,000 (the maximum difference in o!m)
3. The value is then scaled slightly (power function) and multiplied by the maximum AccValue that you could get (the max AccValue is 20% of the chart's StrainBase multiplied by (OD / 10). If a chart is OD9, then the max AccValue of that chart is 18% of StrainBase.)

With this AccValue system, you will get these proportions of a chart's maximum AccValue at these score values:
960K - 0.00%
965K - 10.15%
970K - 21.76%
975K - 34.00%
980K - 46.65%
985K - 59.63%
990K - 72.87%
995K - 86.34%
1mil - 100.00%

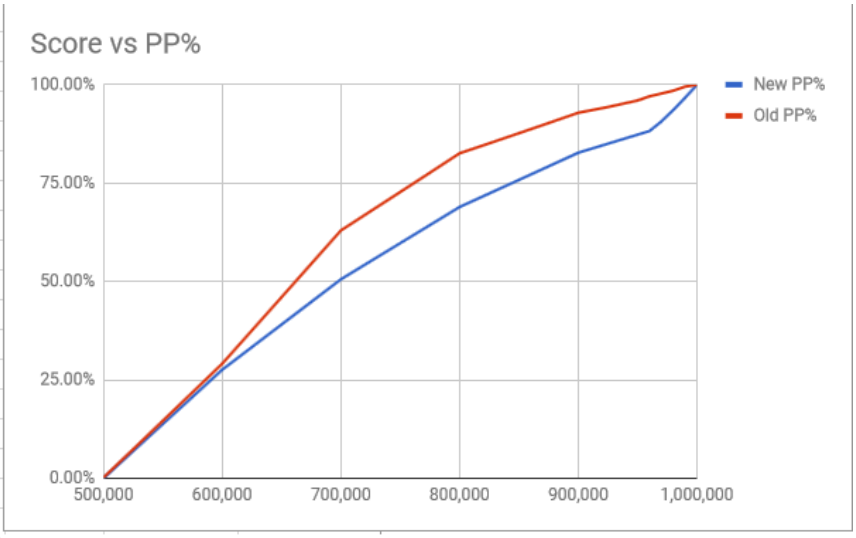
It is worth pointing out that with this AccValue system, **accuracy (per se) is not considered into the PP system at all**. I do not consider this to be an issue because the score component already takes accuracy into consideration to a substantial degree (though not perfectly; I consider the scorev2 system to be far superior in this respect). Additionally, accuracy fails to account for differences between 990K and 1mil, for scores within that range are most likely SS ranks to begin with, which denotes 100% accuracy.

To compute PP, we will use the same formula used to calculate PP based on StrainBase, StrainMultiplier and AccValue as the current system:
((StrainBase * StrainMultiplier)^1.1 + AccValue^1.1)^(1/1.1) * 1.1

The reason why I am not using a different formula is because I am unsure of what the purposes of certain exponents in the formula are. It seems as if it is trying to slightly reduce the weighting of the higher constant between (SB * SM) and AccValue before multiplying a linear constant (1.1), but the reason behind this is something that I am not certain of. The exponents do not seem to have a significant effect, but I am keeping the exponents regardless until I figure out whether there is any intrinsic use for their exponents to begin with.

In summation, you will be getting these proportions of maximum PP (from both the proposed and current systems) at these score values:

Score	New PP%	Old PP%
500,000	0.00%	0.19%
525,000	6.89%	7.36%
550,000	13.79%	14.60%
575,000	20.68%	21.85%
600,000	27.58%	29.10%
625,000	33.32%	37.55%
650,000	39.07%	46.02%
675,000	44.81%	54.49%
700,000	50.56%	62.97%
725,000	55.15%	67.85%
750,000	59.75%	72.75%
775,000	64.35%	77.66%
800,000	68.94%	82.58%
825,000	72.39%	85.12%
850,000	75.84%	87.68%
875,000	79.28%	90.27%
900,000	82.73%	92.89%
925,000	85.03%	94.35%
950,000	87.33%	96.01%
960,000	88.25%	97.07%
970,000	90.68%	97.77%
980,000	93.59%	98.49%
990,000	96.72%	99.52%
1,000,000	100.00%	100.00%

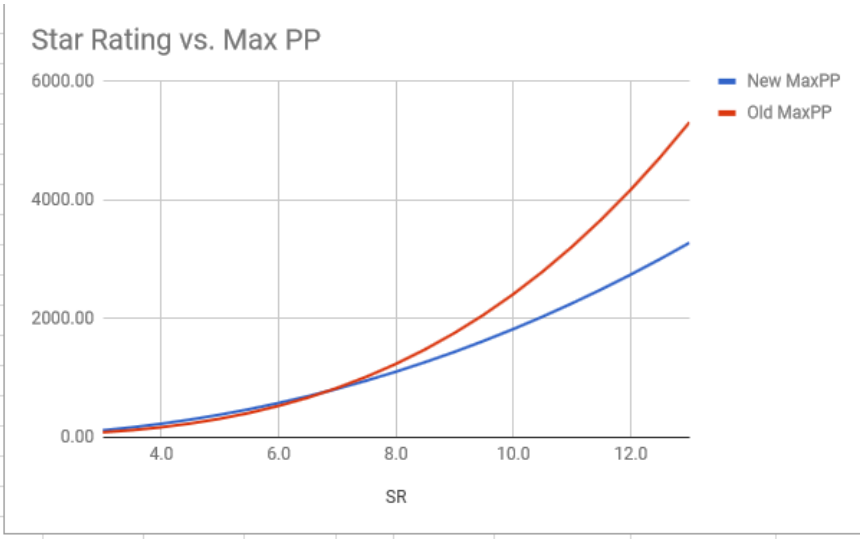


(note: the old PP%s are estimated; this is because AccValue is an absolute value that does not scale with StrainBase. However, for charts that are rated 5 or higher, the PP%s should have an error of about 1% at most.)*

In the proposed system, players will get substantially lower PP%s across all score ranges. However, players will be more incentivized to go for scores within the 725K - 1mil range due to the relative nerf to scores within the 600K - 700K range (34.45% delta vs. 23.31% delta, whereas other deltas beyond 700K in the proposed system are at least 20% stronger relatively and 50% stronger on average).

This is about the maximum PP that you could get from these SR values:

SR	New MaxPP	Old MaxPP
13.0	3281.97	5314.01
12.5	3007.36	4723.18
12.0	2745.78	4178.03
11.5	2497.13	3676.73
11.0	2261.29	3217.43
10.5	2038.16	2798.31
10.0	1827.60	2417.53
9.5	1629.50	2073.26
9.0	1443.73	1763.65
8.5	1270.16	1486.88
8.0	1108.63	1241.12
7.5	959.01	1024.52
7.0	821.14	835.26
6.5	694.85	671.51
6.0	579.96	531.43
5.5	476.30	413.20
5.0	383.66	314.99
4.5	301.83	234.98
4.0	230.58	171.34
3.5	169.64	122.25
3.0	118.74	85.90



In the proposed system, osu!mania's highest ranked play (jakads' Doppelganger Extra +DT run) will be a **1,431pp** (+- 1% due to site/client discrepancies) play. In contrast, his play through the current system nets him **2,414pp**.

In contrast, jakads' Doppelganger Alter Ego will be a **1,477pp** (+- 1%) play. The reason why Alter Ego is considered a better performance than the Extra DT run is because of his extremely high score (**989,970**, which triggers the AccValue bonus) and Doppelganger [Alter Ego] being more overrated than Doppelganger [jakads' Extra] +DT.

Charts that are 6* or less should not be greatly affected by this, as the maximum potential PP for these charts in the proposed system should counter the general decrease in PP% across all score ranges. Players should also expect a potential PP increase for scores that they have gotten >960K on.

How does this impact players who use DT/HT?

Almost every DT play beyond 6* will be given considerably less PP (about 6 - 40%, not a very useful range). This could be attributed to either a lower maximum potential PP for that SR (for SR > 6.9), or a lower PP% due to a more stringent StrainMultiplier formula. However, DT should still be a mod that is more than viable to farm PP from; it is just that you are far better off farming scores that give you scores that are above 850K than 650K. A score that would net you 64% of the maximum potential PP of a chart in the old system (700K) would require you to attain close to 780K in the proposed system. **As a general rule of thumb, if you would like to**

attain the same PP% in the old system, you would need to earn 80K - 120K to get the same level of PP% in the proposed system.

There will also be **less incentive to use DT if you are going for 600K - 700K scores**, and more incentive to use HT if you are going for 980K scores (assuming that you cannot get >750K on NM) or if you cannot get >710K on the chart on NM in general.

Assuming that you have a 980K score on a chart on NM and that DT gives a 30 - 40% increase in SR, you need about 675K - 710K to get the same amount of PP on DT compared to what you would get on NM. 675 - 710K is about the area where players will be hitting patterns to sustain accuracy rather than combo and HP. In contrast, you would need about 620K - 640K to get the same amount in the old system, which is almost always mashing. Thus, as long as some players will have some level of competence in hitting the patterns present in the chart (assuming that the difficulty of the chart is about constant), they should be earning more PP through DT over NM.

Assuming that you have a 950K score on a chart on HT (this is the typical upper bound for players who play the chart on HT; people who attain higher scores than that would typically play on NM instead because they have already attained a level of competence to hit the patterns at a higher speed) and that NM gives a 25% increase in SR, you need 710K to get the same amount of PP on NM compared to what you would get on HT. Players would require about 685K to get the same amount in the old system. This change will incentivize players to play on HT for a little longer, but I do not expect the impact of the proposed system on HT to be very significant.

At the very most, players will go for 990K+ scores on HT over 750K scores on NM (since the former will give more PP than the latter), but again, I do not consider this to be a thing; finer levels of accuracy are overlooked in the current meta, and the AccValue system is doing its job by incentivizing people to go for very high scores on easier charts.

What are the limitations of the system?

This PP system is still based on a fundamentally flawed element, that is Star Rating. This means that scores (across different songs) still cannot be compared easily. Charts that are particularly overrated or have very short difficulty spikes are most likely going to be players' top plays. This includes charts like **Doppelganger [Alter Ego], Elegance Lunatic, Dreadnought [Onslaught], Triumph & Regret, Capsaicin (both difficulties)**, and among others. A quick solution to deal with cases of short difficulty spikes would be to use more intervals to calculate the SR of a chart, but that is another band-aid for a far larger underlying problem (that being the fact that SR does an extremely poor job at parsing patterns to give a proper difficulty value).

StrainMultiplier is also a fundamentally flawed principle. This is because StrainMultiplier assumes that every chart has the same difficulty curve as score increases (considering that the difficulty is something is always based on a certain goal in mind). This is fundamentally

incorrect; a chart with 2 seconds of a very hard section with 3 minutes of filler will have a substantially different difficulty curve compared to a chart with 2 minutes of hard patterns.

Ideally, the SR system should be able to assess difficulty for multiple score ranges (though accuracy is a better metric -- ideally 85%-99% accuracy?) while displaying an SR value for the most commonly pursued goal in osu!mania (~850K/96% scores) in the song select screen. This should make the StrainMultiplier value mostly obsolete, since we can then assess a score's "performance" by the difficulty of achieving a specific score or level of accuracy. However, it is near impossible to create a SR system that accounts for 85 - 100% (especially with scorev2, which takes rainbow 300s into consideration differently from normal 300s), so an AccValue system will always be required. The values in the AccValue system can always be tinkered after scorev2 is rolled out as well, but I would prefer to see an AccValue that also takes into consideration rhythmic complexity. An overhaul of the AccValue system is not something that I expect to see happen over the next year, for it is pointless to work on the AccValue system without working on a better SR system.

The values in the StrainBase system may also have to be tinkered when a new SR system rolls out, but this is an easy fix (by comparing this proposed iteration of SB with the future iteration of SB).

However, this system should be better than the extant PP system by incentivising players to go for 725K - 1mil scores more than the extant system by about 20 - 50% (with a relatively higher incentive for higher scores). Considering that 725K is the absolute upper bound for "hitting patterns to sustain HP and combo", players would be pursuing competency to hit patterns to the degree where they can sustain high accuracies on those charts rather than merely HP and combo.

This band-aid is extremely easy to implement (since it only involves changes in numbers and simple formulae), and I have tested this system through both simulation and real scores and discussed the system's outputs with other community members. All of them strongly preferred this proposal over what is currently used.

The bigger concern now would be to create a better SR system, and I have some ideas for it, but I do not have the ability to create nor the ability to commit to create a system like that.

I hope that this fix would be of some value to the developers.

Shoegazer (March 9, 2018)