Two Year Anniversary

28 December 2020

Jim Stevenson

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And so another year has passed—a pretty horrible one at that. Hopefully things mathematical have provided a distraction and entertainment.

I thought I would update the retrospective from a year ago. Clearly, this eventful year made itself felt even through the statistics I gathered from the website. The growth the site experienced in posts read hit a plateau, but strangely, the number of new visitors increased a bit, at least for a while. That may have been due to the greater amount of free time away from the classroom that the virus demanded.

Anyway, here is the summary.

Meditations on Mathematics Website Visit Summary

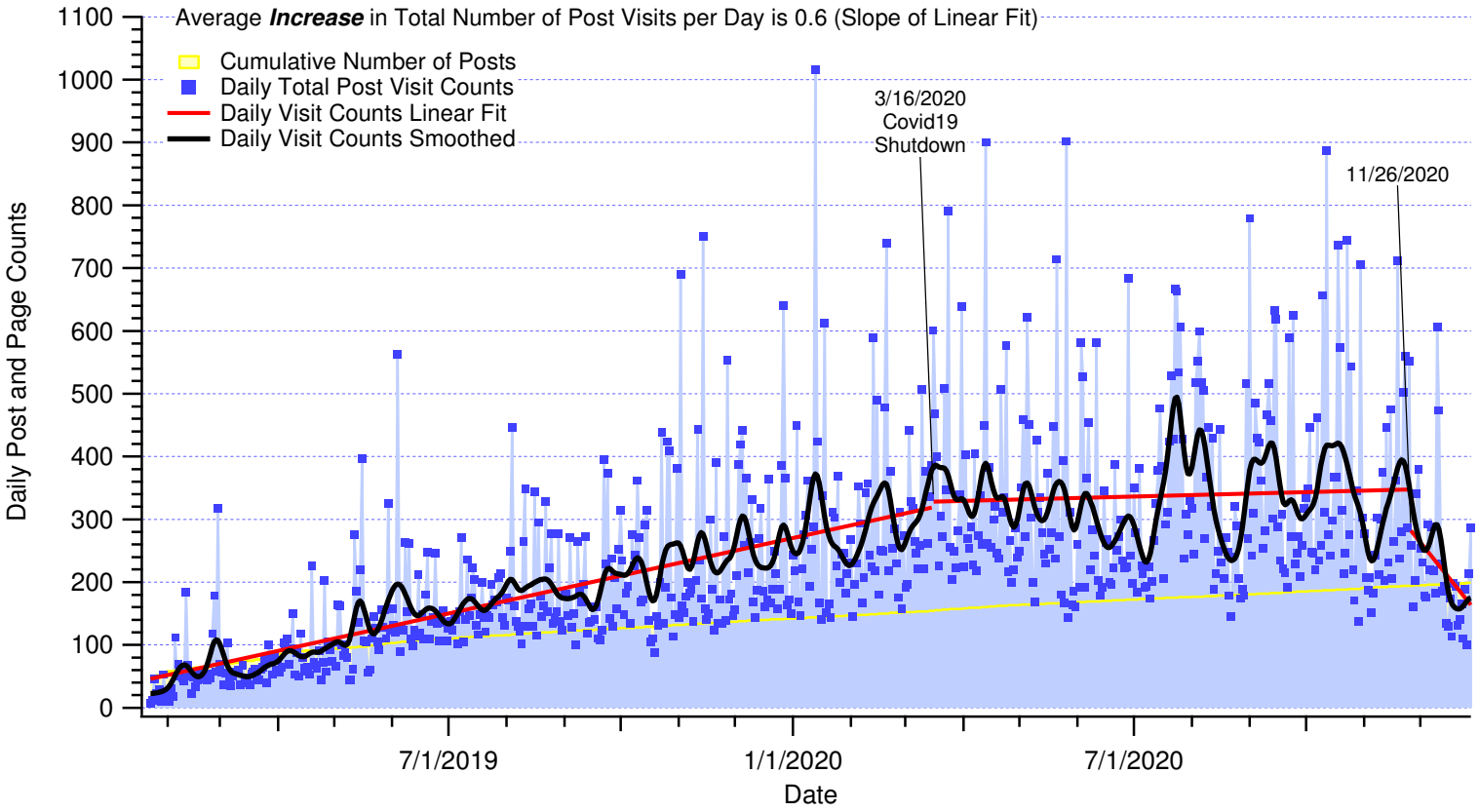
28 December 2020

Jim Stevenson

I used the Igor analysis tool to assemble and display what data I was able to capture using a simple post visit counting widget. It turns out that there are a number of curious patterns that I don't always understand.

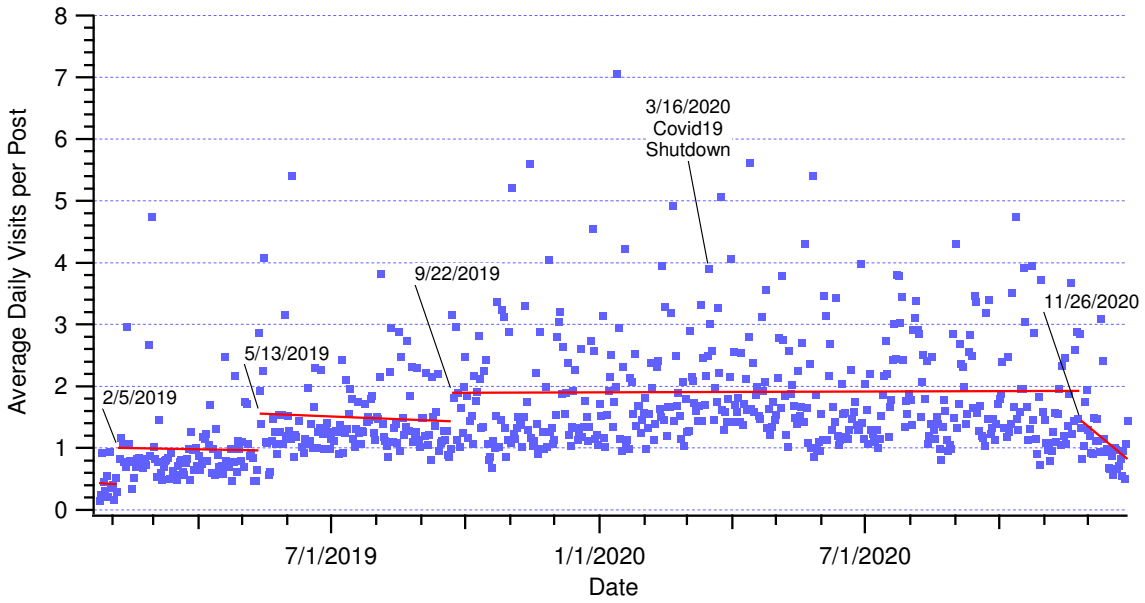
Daily Post Visits. The first of a number of surprises is shown in Fig. 1. The daily total number of visits gyrates wildly from day to day, but the overall initial trend is a *constant* 0.6 *new visits per day*, that is, the linear fit has a stable constant slope of 0.6. This has held steady for months, independent of the type or number of posts or number of visitors, at least up to the arrival of the coronavirus

Fig. 1 Timeline Daily Post Visits (23 Jan 2019 – 28 Dec 2020)



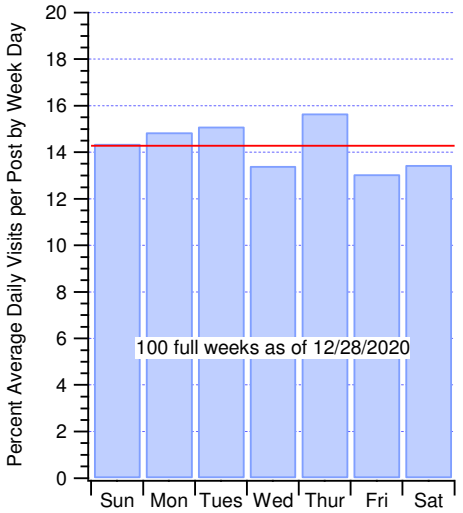
infection or Covid-19 in March 2020. Then there were sudden bursts and drops of post visits, followed by a precipitous drop in visits in December, even though the new visitor rate held more or less constant, as I will show below. Then there is the unusual high-frequency oscillation of the smoothed visit count line. I have no explanations for these behaviors.

Fig. 2 Average Daily Visits per Post (Daily Total Visit Count/Cumulative Posts) (28 Dec 2020)



Average Daily Visits per Post. As the number of posts I uploaded increased, I thought a fairer measure of the number of post visits should be a normalized number. So I divided the total number of post visits in a day by the total number of postings that were on the website on that day. This gives sort of an average number of daily visits per post for all the posts, as shown in Fig. 2. A new pattern showed up, where by the end of January 2019 each post received about a half visit per day, then for February 2019 through half of May 2019 each post received roughly one visit per day, followed by one and a half visits per day for each post from mid-May through most of September 2019, where then we were averaging about two visits for each post per day, though with an apparent increase during the March 2020 shutdown for Covid-19. The precipitous drop in visits shows up after Thanksgiving 2020.

Fig. 3 Percent Visits per Week Day



Percent Visits per Week Day. Using these normalized numbers, I decided to investigate the daily scatter a bit more closely, that is, was there a pattern to the average daily visits per post. Sure enough, Fig. 3 reveals a weekly pattern. If visitors were reading posts randomly throughout the week, I would expect 1/7 ≈ 14.3% of the week's visits to occur on each day of the week (represented by the horizontal red line in the figure), but that is not the case. After almost 2 years of data Thursday still seems to be the most preferred day to visit the website and Friday the least, with Wednesday a close second. This pattern showed up last year and has persisted. What gives? What is so special about Thursday in the week? Weird!

Number of New Visitors per Day. Related to this is the number of new visitors per day. This takes some inference to estimate. I assume that a new visitor will relatively soon look at the About page. Since that page is rarely updated, a repeat visitor will probably not look at it again. Therefore, I am using the number of visitors to the About page as an estimate of new visitors per day (some may look at the page more than once, some may not look at all, so hopefully it averages out). As Fig. 4 and Fig. 5 show, since 1 June 2019 the average number of new visitors has held steady at about 4 per day. Why? I don't know. Where are they coming from? How come it averages at 4? There are some day-to-day variations (especially around the Covid-19 lockdown in March 2020), but no trends that last longer than a few days, and so the overall average stays constant at 4—until June 2020. Then the rate jumped to 6 per day for two months and then decreased to 5 per day for 3 months until the sudden drop back to 4 per day (at least so far) in December. What was fairly steady last year has become very oscillatory this year—again, I haven't a clue as to the reason for these patterns.

Fig. 4 Cumulative Number of About Visits (28 Dec 2020)

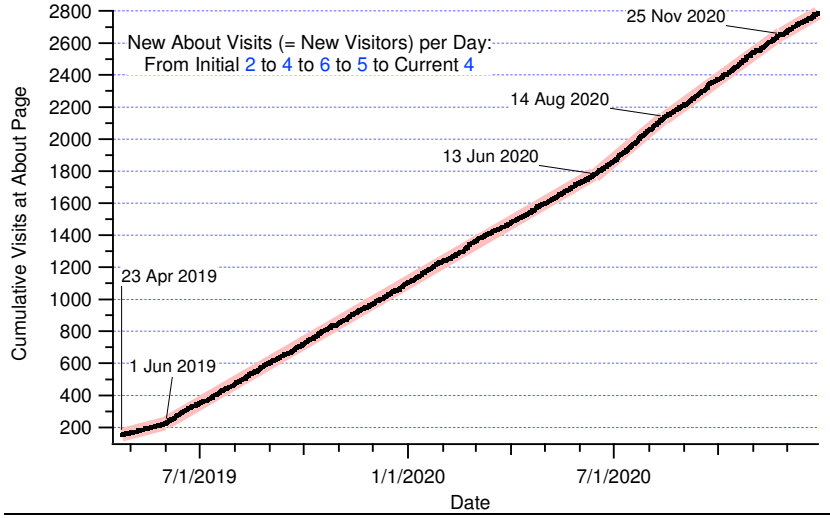
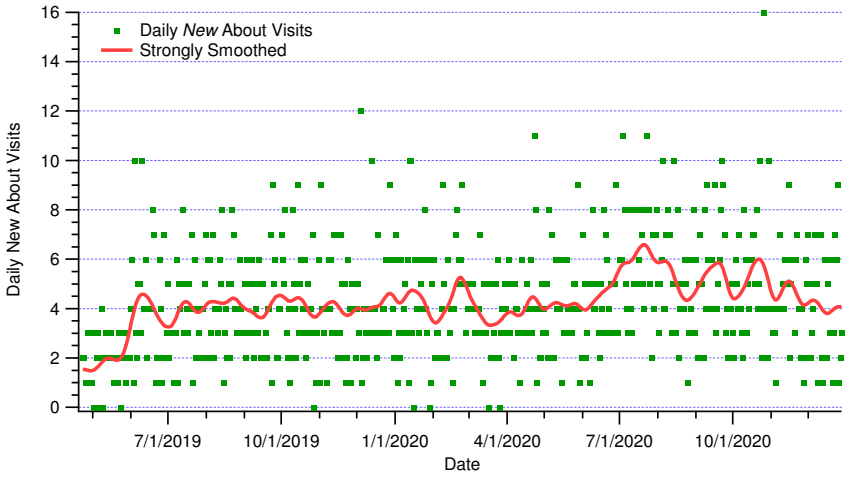


Fig. 5 Daily *New* About Visits (28 Dec 2020)



Daily Visits per Post per New Visitor. The idea behind Fig. 6 (next page) is to see if the increased average number of posts visited in a day might be due to an increased number of visitors that day. This figure takes the Average Daily Visits per Post (Fig. 2) and divides it by "essentially" the number of new visitors that day (Fig. 5).

The qualifier "essentially" refers to the fact that the number of new visitors is smoothed a bit. This is to cover the situation where there may be a very large number of visitors one day and none the next. The large number of visitors spreads their reading over several days, so they bring a locally heightened level of posts visited per day, and dividing by 0 would create an unrealistic anomaly.

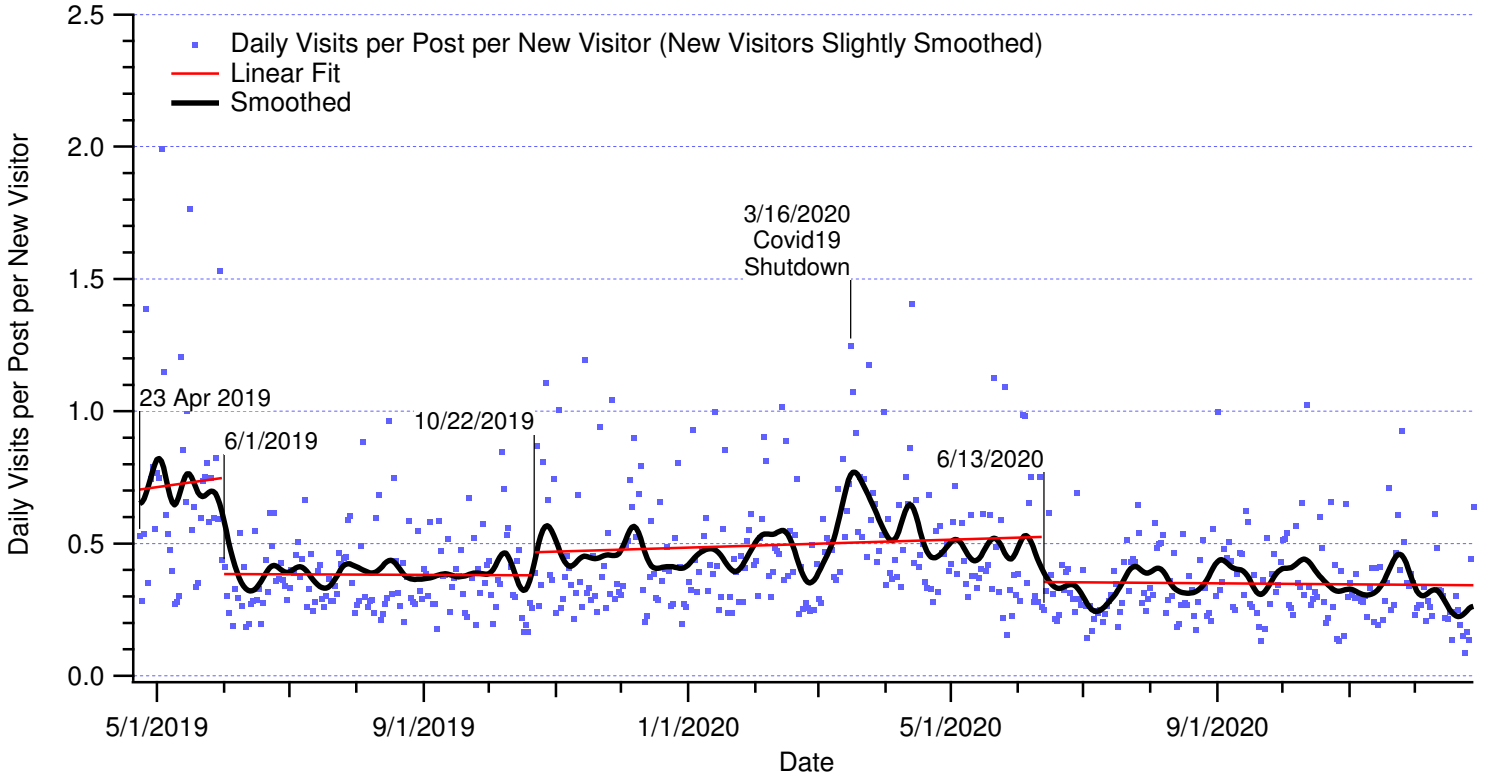
We can see that once we move past the early low number of postings and low rate of new visitors (1 June 2019), the plot shows a fairly stable pattern up to 22 October 2019. It rises to a new, fairly constant rate after that date (though with some major excursions

around the onset of Coved-19 quarantine in March 2020). This tends to confirm that the increase in average number of posts visited in a day is due to more new visitors that day.

There is a recent trend since 13 June 2020 that breaks the pattern. As we see from Fig. 5 and from Fig. 2, the number of new visitors increases substantially but the average number of post visits remains constant. This is reflected in Fig. 6 where the trend line takes a dive. I have no explanation.

Fig. 6 Daily Visits per Post per New Visitor (28 Dec 2020)

(For Each Day: (Total of all Post Visits) / (Current Number of Posts * Smoothed New About Visits))

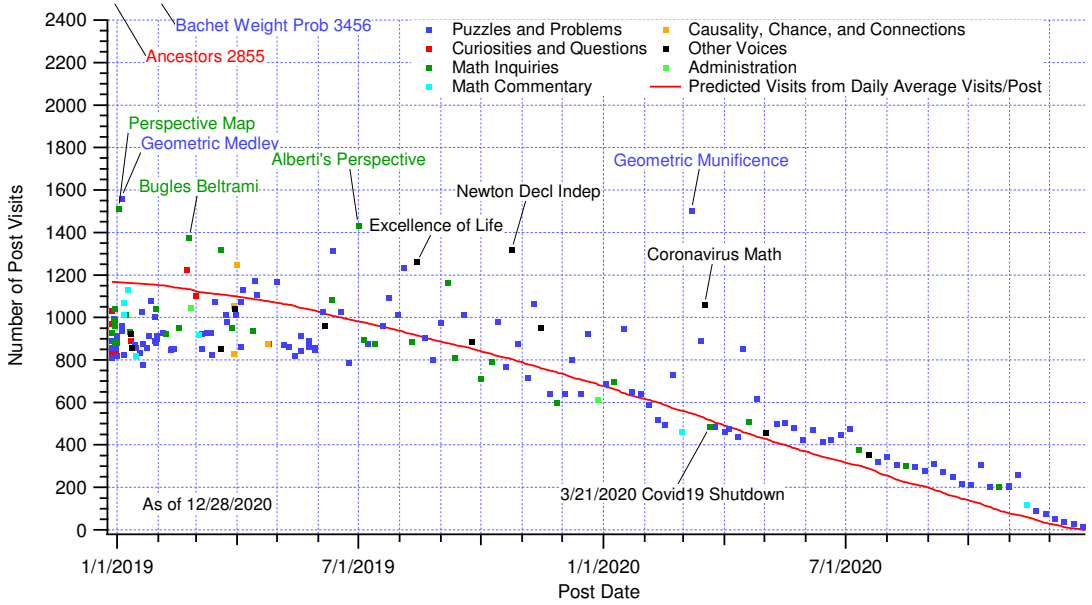


We turn now to look at the behavior of individual postings.

Individual Cumulative Post Visits. Fig. 7 represents the cumulative number of visits to each post as of the latest snapshot date. Taking the values from the "Average Daily Visits per Post" plot above (Fig. 2), the red line shows how many accumulated visits a post should be expected to have if its post date had been at any point along the x-axis. This is a way to gauge the interest in a post. Those that fall below the red line have less than average interest, and those above have more than average interest.

Clearly the newer posts hold more interest than the older ones, but interest in the old posts does not completely disappear, since most currently show more than 800 visits. A certain stability creeps in after the Covid-19 shutdown that may reflect a diminishing interest (there may be too many puzzles rather than commentary).

Fig. 7 Most Recent Snapshot of Cumulative Post Visits (28 Dec 2020)



See Fig. 9 regarding the sudden explosion of interest in the Ancestors and Bachet Weight Problems. (By the way, the visit count numbers for these two posts are so large, that they skew the average (red line) to be higher than expected, given the behavior of the other posts.)

Average Daily Post Visits Since Posting. Fig. 8 gives a different view of how popular a posting is over time and how it diminishes in interest. For each post the total number of visits as of the most recent snapshot is divided by the number of days since the posting date. What is interesting is that even for the oldest posts the average does not drop below at least one visit each day. Of course the newer posts receive the most attention with a higher average number of visits. And then there are the outliers: older posts whose average number of visits is well above one per day, such as the Ancestors Problem and Bachet Weight Problem.

Fig. 8 Average Daily Post Visits Since Posting (28 Dec 2020)
(Cumulative Post Visits / Days Since Posting)

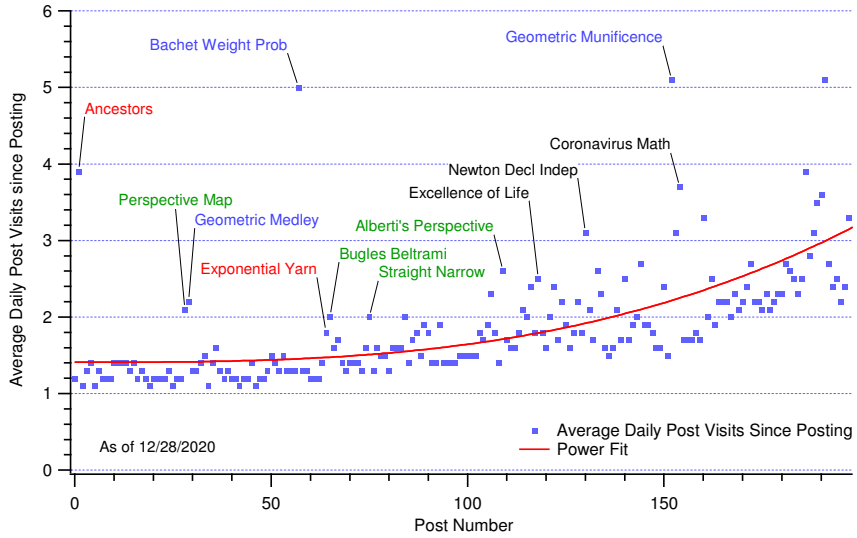
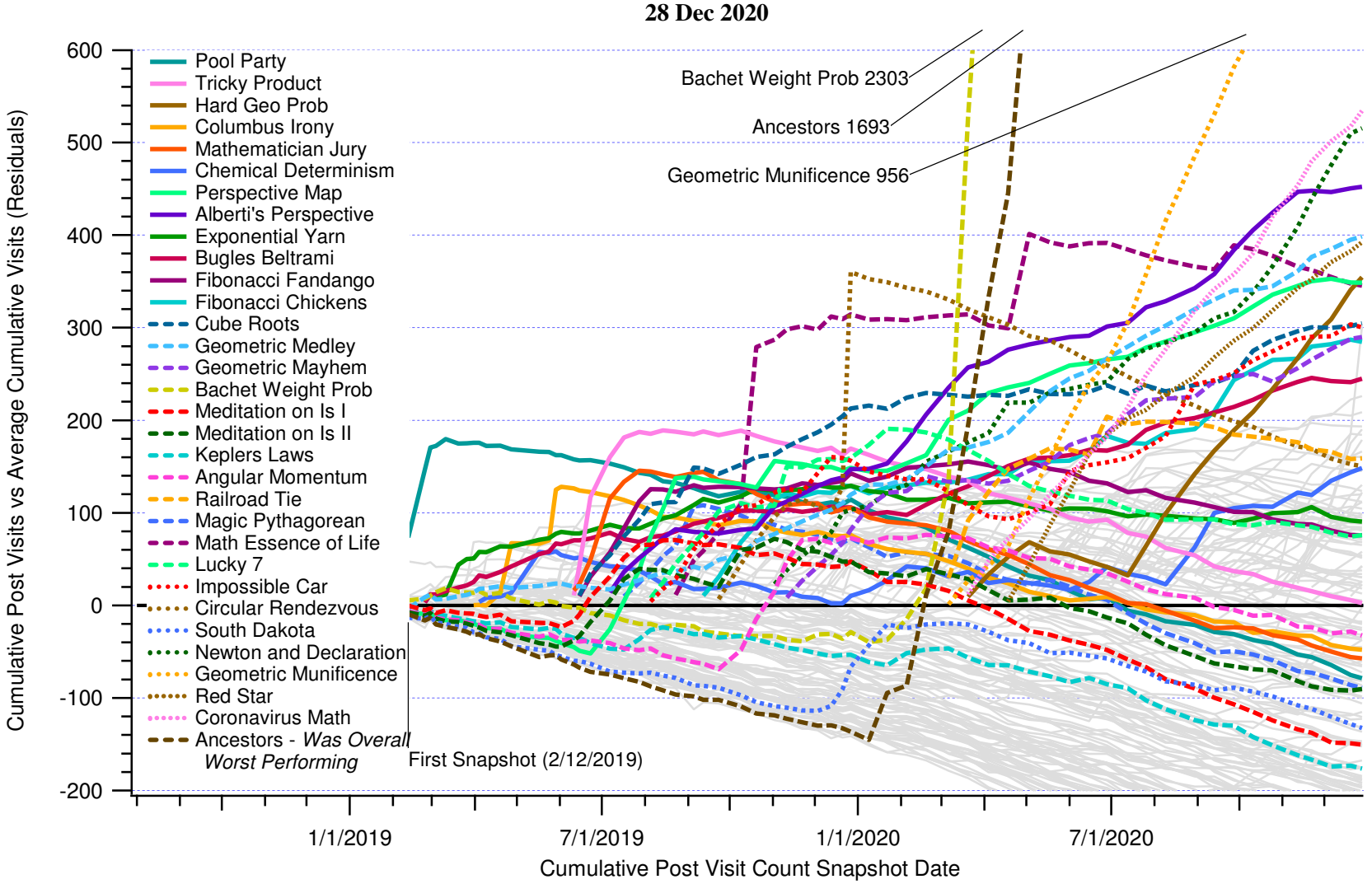


Fig. 9 Individual Cumulative Post Visit Timelines Relative to an Average Cumulative Post Visit Timeline (Zero Line)



Individual Post Visit Timelines. Fig. 9 gives the individual timelines of the snapshots of the Post Visit counts shown in the previous plot (Fig. 7). Furthermore, the difference between each cumulative Post Visit count and the cumulative average Post Visit

count (shown as a red line in Fig. 7) is shown instead of the raw Post Visit counts. The first snapshot occurred on 12 February 2019, which is the start of the plot. Some Posts had already been uploaded by then and had accumulated differences with the average.

There are some fascinating patterns to the timelines. The more significant ones have been highlighted in color. For example, the Perspective Map, was among the least popular until suddenly at the end of June 2019 it surged in interest. This might be attributed to interest in the Alberti's Perspective post, which was posted on 7/1/2019, a date between the snapshot dates of 6/23/2019 and 7/7/2019 where the Perspective Map showed its turnaround. But there also appears to be a burst of interest in many of the new posts, and some of the old posts, around the end of May and beginning of June 2019. Perhaps this is due to students getting out of school for the summer vacation.

Many of the postings show a peak in interest followed by a steady decline. Some, such as the Exponential Yarn, Bugles Beltrami, and Geometric Medley show a steady or eventual increase in interest. The slopes of posts with declining interest all appear similar, which suggests a puzzle to solve. A working hypothesis might be that initially a new post garners attention from all the current visitors, after which it is only the new visitors that have an interest. So the decline is not as fast as it would be if everyone stopped reading the post, but it is faster than the average rate of reading posts.

Then, of course, is the startling rise of the Ancestors Problem and the Bachet Weight Problem after 22 January 2020. No explanation at this time. The Ancestors Problem rise is especially curious, given that it was the post of least interest up to the January 2020 snapshot date. It appears it has received the bulk of the spam subsequently, so perhaps that is the reason (though I don't understand the post count widget well enough to know if it counts spam).