

Three Year Anniversary

28 December 2021

Jim Stevenson



Yet another year has passed, with dimming hopes for a return to “normal” from the pandemic. Newton’s great achievements occurred during a similar time, so maybe something positive will arise out of our current difficulties. As always, I hope things mathematical have provided a distraction and entertainment—and possibly even enrichment.

Again, I thought I would present the statistical pattern of interaction with the website in the absence of any explicit feedback. I can’t draw any firm conclusions other than interest in the website seems to have reached a permanent plateau, and possibly a point of diminishing interest. A cursory survey suggests that such websites as this have a half-life of about 3 years, so maybe it is a portent.

Anyway, here is the summary.

Meditations on Mathematics Website Visit Summary

28 December 2021

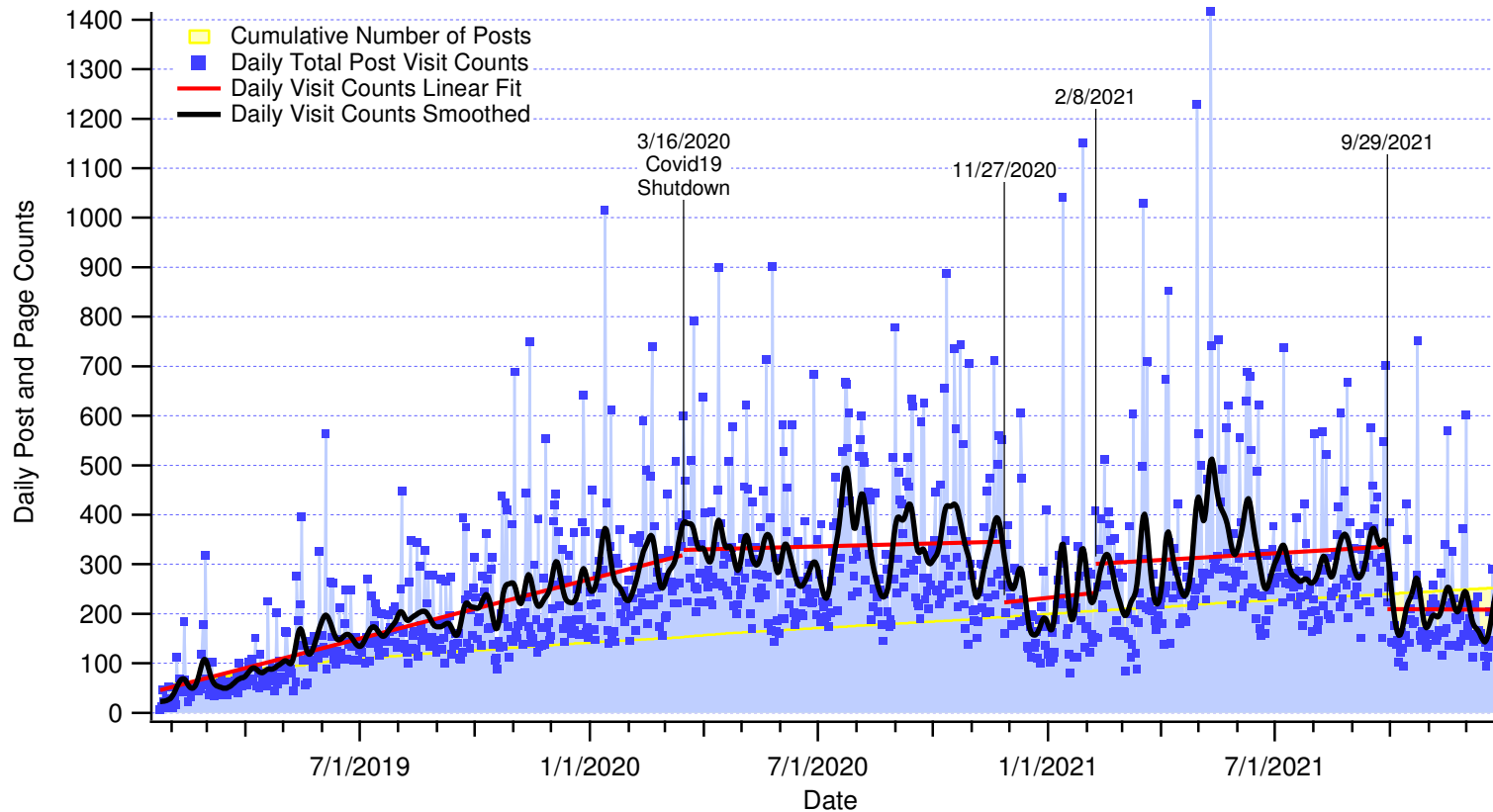
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I continued using the Igor analysis tool to assemble and display what data I was able to capture. There are still a number of curious patterns that I don't always understand.

Daily Post Visits. The initial trend of a constant 0.6 new visits per day (linear fit with a stable constant slope of 0.6) 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 infection or Covid-19 in March 2020. Then there was an overall plateau of about 350 post visits per day, followed by a precipitous drop to about 200 visits in December 2020, even though the new visitor rate held fairly

Fig. 1 Timeline Daily Post Visits (23 Jan 1919 – 28 Dec 2021)



constant, as I will show below. The visits more or less rebounded to the 300-350 per day rate in February 2021, but then again dropped abruptly to below 200 per day in October 2021 and have remained there. The two winter drops in 2020 and 2021 may be due to students returning to school.

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.

But the visit plateaus shown in Fig. 1 while the cumulative number of posts increased meant that the visits per post would start to diminish, as is the case in Fig. 2. The severe drop in the winter of 2021 may also be due to online fatigue and more attention given to inclass schooling.

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. Fig. 3 shows the result. If visitors were reading posts randomly throughout the week, I would expect $1/7 \approx 14.3\%$ of the week's visits to occur on each day of the week (represented by the horizontal red line in the figure). Initially, when I was considering over 2 years of data, that was not the case: Thursday seemed to be the most preferred day to visit the website and Friday the least, with Wednesday a close second.

But now I decided to only show the last year's worth of data to eliminate the dominance of the beginning. Except for the natural drop-off of interest on Saturday, there is little distinction in interest among the other days of the week—the special deviations for Wednesday, Thursday, and Friday have disappeared.

Fig. 2 Average Daily Visits per Post (Daily Total Visit Count/Cumulative Posts) (28 Dec 2021)

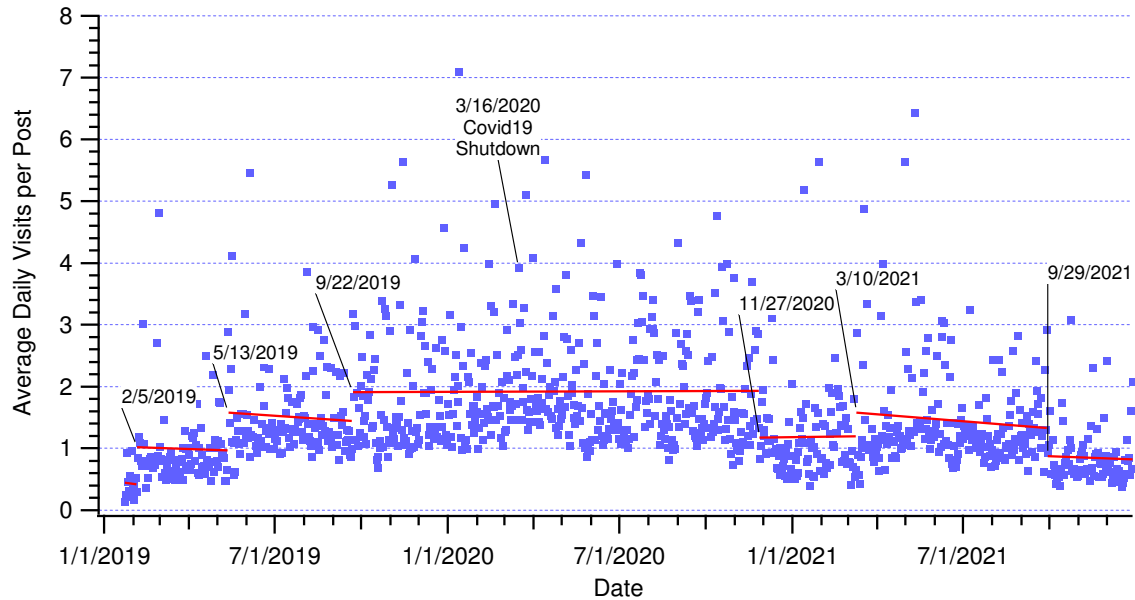
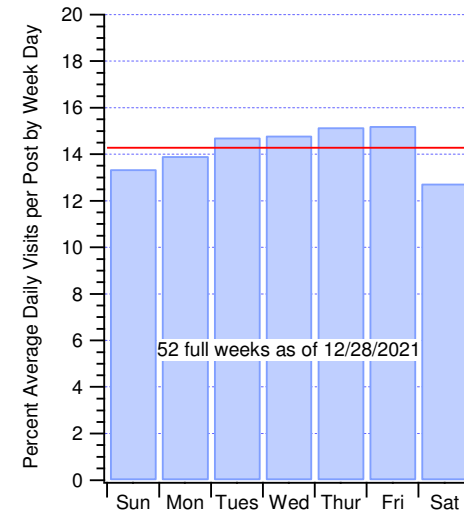


Fig. 3 Percent Visits per Week Day



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 often 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 in December 2020. This persisted until a bigger jump to 7 new visitors per day in the spring of 2021, followed by a return to 4 per day in the summer of 2021.

The real concern is the sudden drop this winter of 2021 back to the original 2 new visitors per day. This was driven partly by the large number of occasions when there were no new visitors per day as shown by the blue ellipse in Fig. 5. So perhaps interest in the website is finally waning.

Fig. 4 Cumulative Number of About Visits (28 Dec 2021)

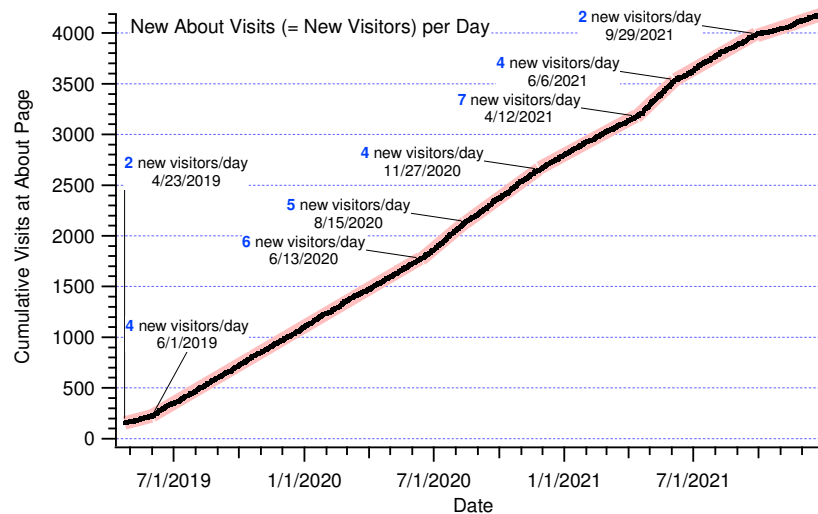
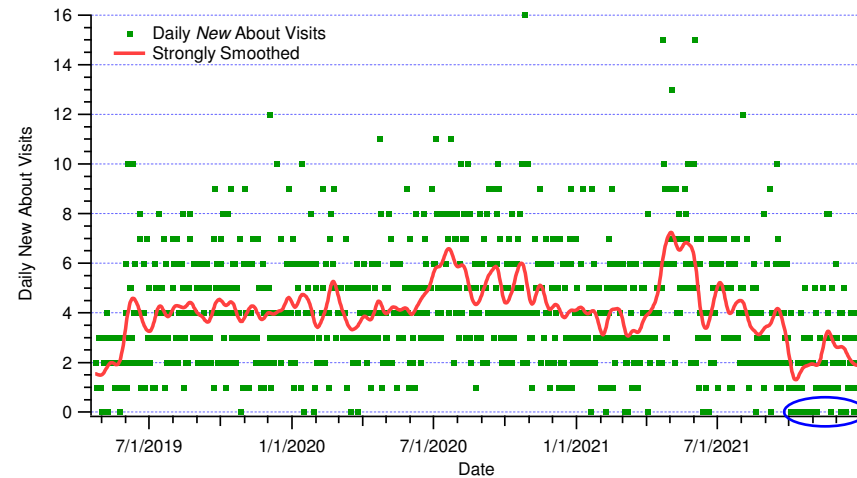


Fig. 5 Daily New About Visits (28 Dec 2021)



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

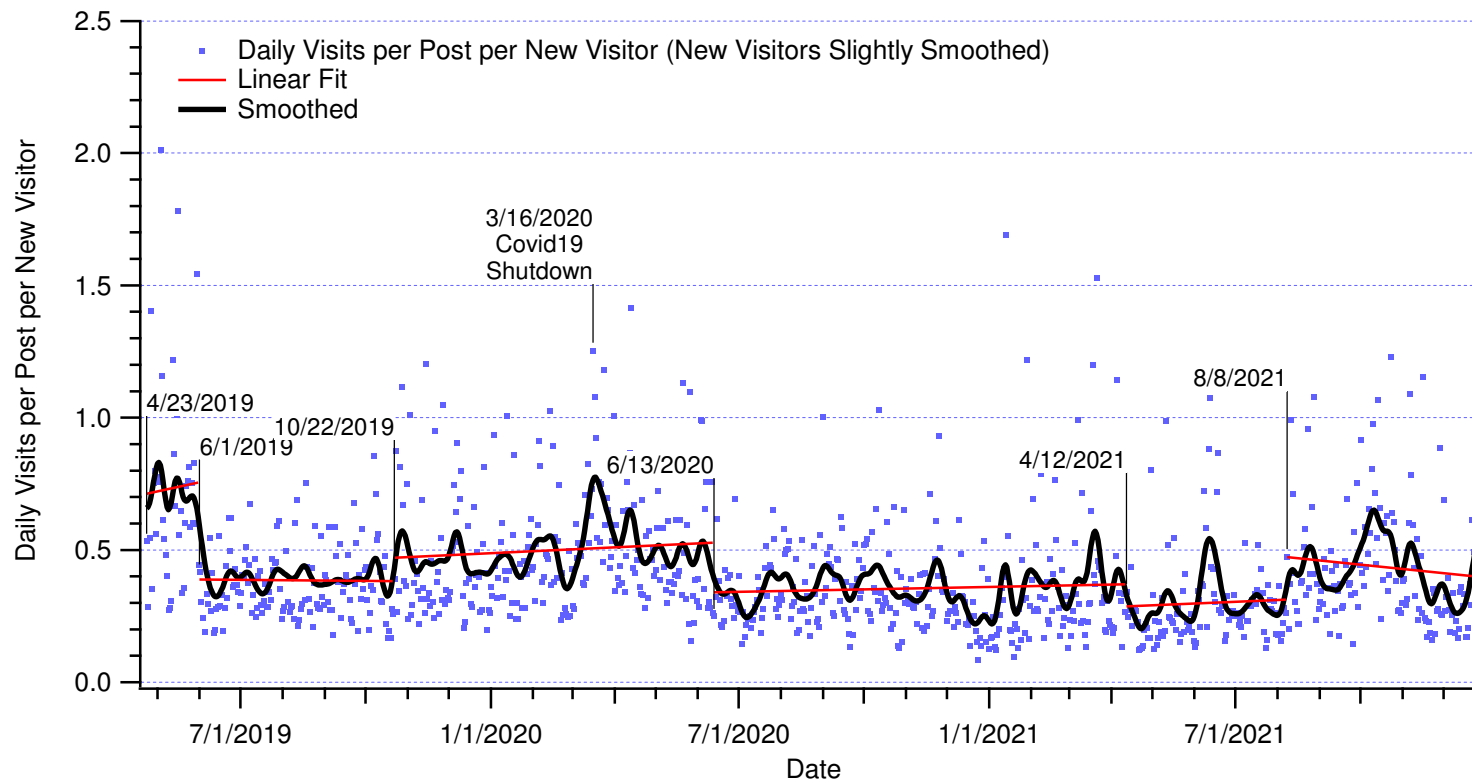
divides it by “essentially” the number of new visitors that day (Fig. 5).

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.

To some extent the fairly constant visit segments support the idea that the number of visits per post varies in tandem with the number of new visitors. However, the volatility of the last six months weakens this conclusion somewhat.

Fig. 6 Daily Visits per Post per New Visitor (28 Dec 2021)
 (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.

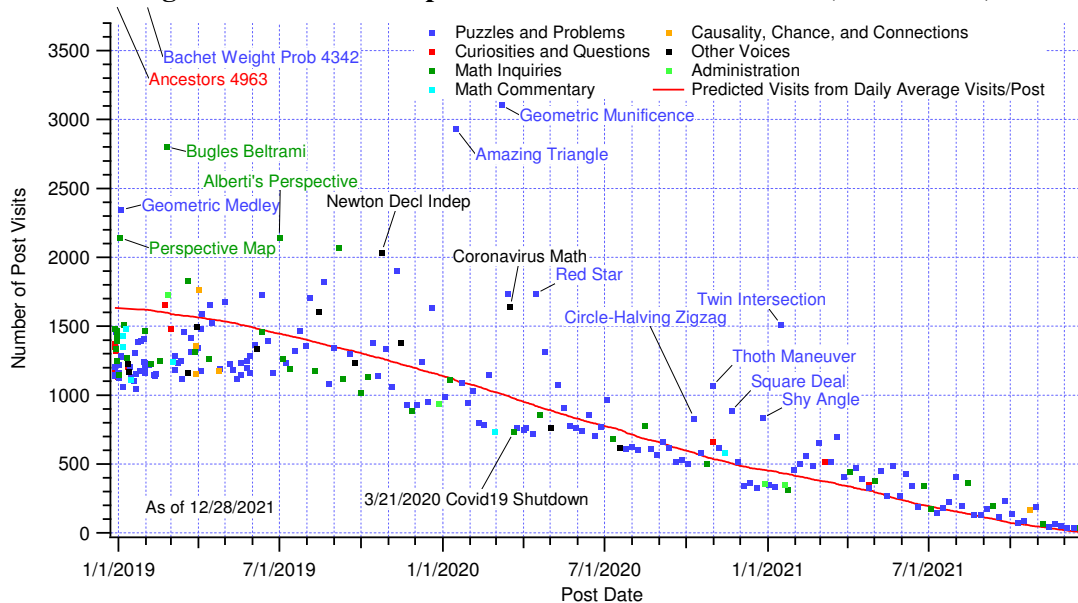
Individual Cumulative Post Visits. Fig. 7 represents the cumulative number of visits to each post as of the latest snapshot date. Taking the values from the “Average Daily Visits per Post” plot above (Fig. 2), the red line shows how many accumulated visits a post should be expected to have if its post 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 the oldest currently show more than 1000 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).

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. 7 Most Recent Snapshot of Cumulative Post Visits (28 Dec 2021)



**Fig. 8 Average Daily Post Visits Since Posting (28 Dec 2021)
(Cumulative Post Visits / Days Since Posting)**

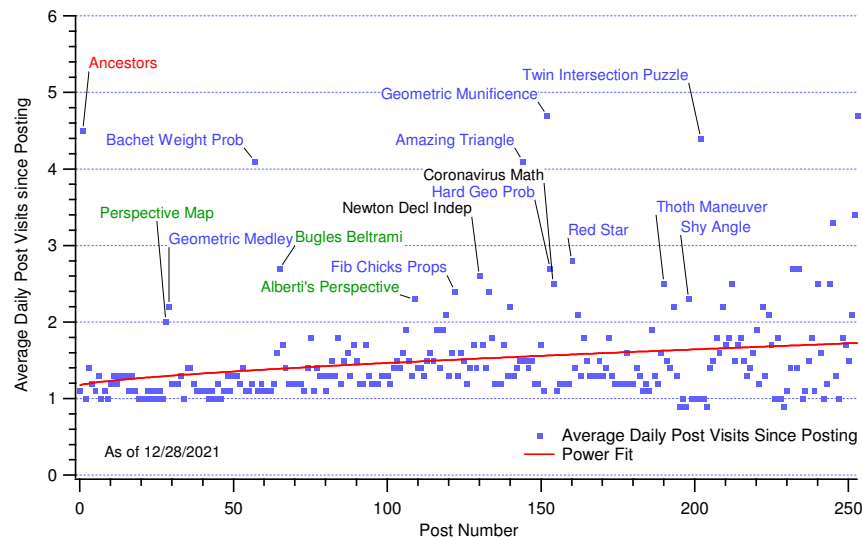
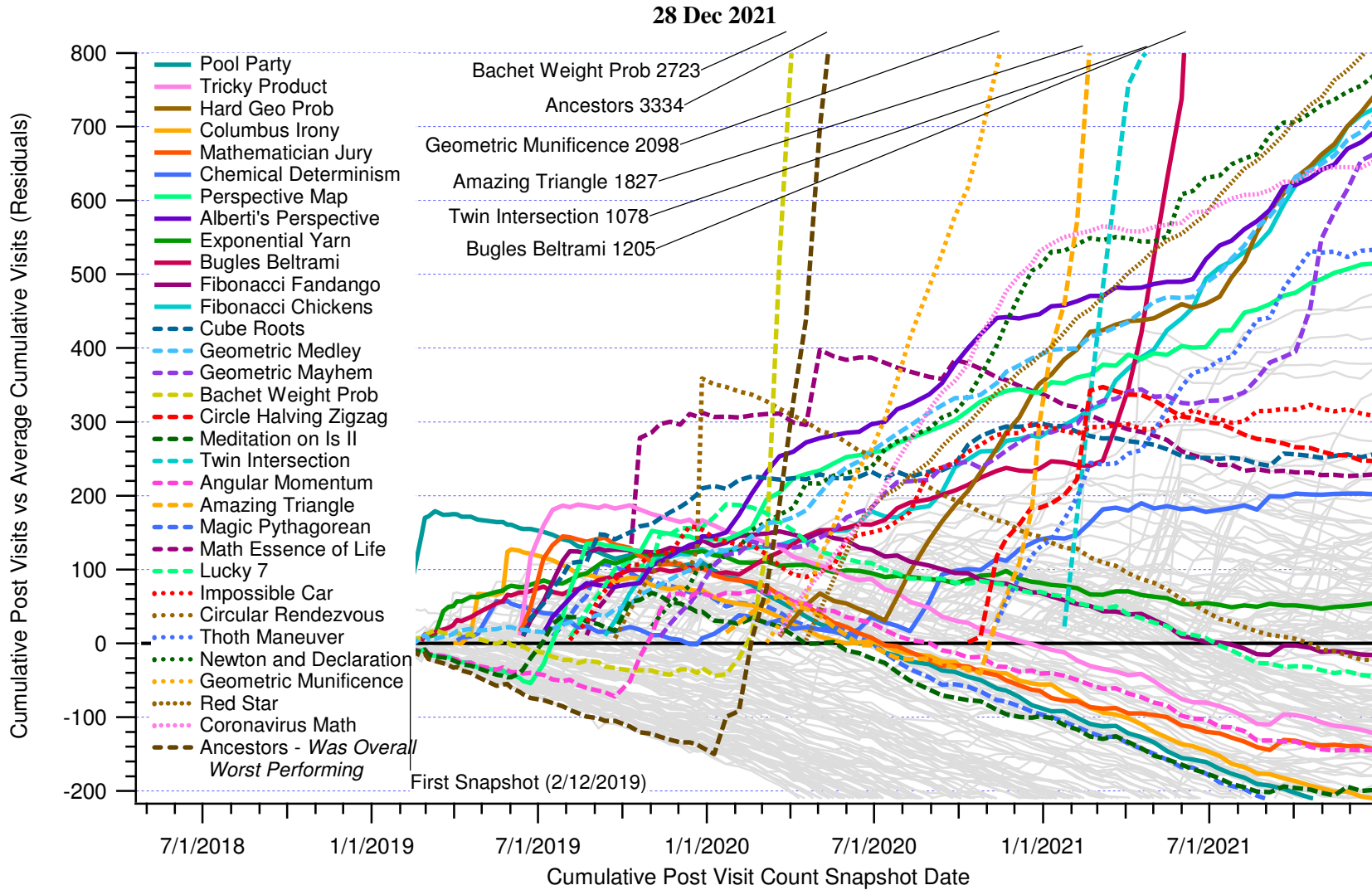


Fig. 9 Individual Cumulative Post Visit Timelines Relative to an Average Cumulative Post Visit Timeline (Zero Line)



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. This offers a better level playing field, since otherwise older posts would have higher visits just by virtue of being around longer. 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.

The startling rise of the Ancestors Problem and the Bachet Weight Problem on 22 January 2020 after a lackluster beginning still persists. They are now joined by Bugles, Trumpets, and Beltrami, posted on 2/24/2019, which suddenly took off mid March 2021, and the Amazing Triangle Problem, posted on 1/16/2020, which took off at the end of October 2020. Two other posts show “off the chart” growth, but from their very beginning:

Geometric Puzzle Munificence (3/7/2020)

Twin Intersection Puzzle (1/16/2021).

The rest of the top posts in descending order of visits are:

Geometric Puzzle Medley (1/4/2019)

Perspective Map (1/2/2019)

Alberti's Perspective Construction (7/1/2019)

Fibonacci, Chickens, and Proportions (9/6/2019)

Newton and the Declaration of Independence (10/24/2019)

Geometric Puzzle Mayhem (11/10/2019)

Red Star (4/15/2020)

Hard Geometric Problem (3/14/2020)

Coronavirus Mathematics (3/17/2020)

Thoth Maneuver (10/31/2020)

I think much of the persistence of some of these top posts comes from the Top Ten list on the website. New visitors probably consult these early on. Otherwise, I don't understand the popularity of the Ancestors and Bachet posts. The popularity of the Geometric Puzzle posts clearly comes from the expertise and appeal of Catriona Agg's creations. I am especially pleased with the interest in the Bugles and Perspective posts, since those involved a fair amount of math and graphics effort to produce. The Fibonacci post appealed to me, since it addressed a number of historical issues and confusing notions associated with fractions and proportions. I am not sure why the Red Star post is so popular.

Many of the postings show a peak in interest followed by a steady decline. 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.

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