

Five Year Anniversary

28 December 2023

Jim Stevenson



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So I managed to make it five years. Again, I thought I would present the statistical pattern of interaction with the website in the absence of any explicit feedback.

But as the summary shows, the fall-off of visitors that began in the middle of last year has persisted throughout 2023. I have also run out of much new material, so I am basically going to wrap it up. I have a few things in the hopper, but they are mostly similar to puzzles already presented. I have one or two essay ideas left, but again I have mostly said what I have to say, and the world of math has moved on.

Anyway, here is the summary for what it's worth.

Meditations on Mathematics Website Visit Summary

28 December 2023

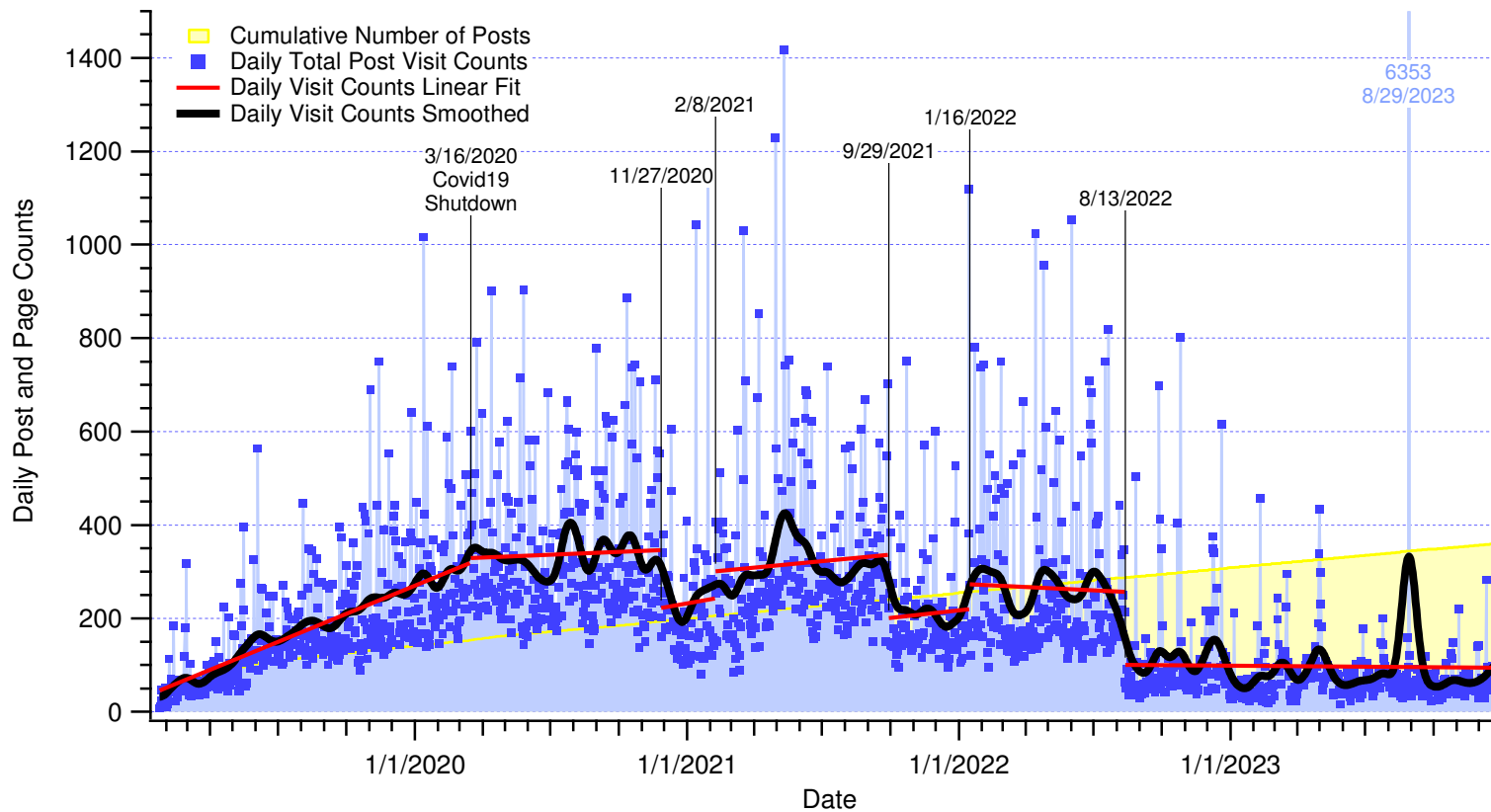
Jim Stevenson

Again I have updated my previous years summary with the results from this past year. It looks like a permanent trend has shown up after coming out from under the pandemic.

Daily Post Visits. Interest in the website seems to have peaked during the first year of the pandemic. There were fairly precipitous

drops in interest during the three winters of 2020-2022, especially 2022 where visit counts dropped to levels that were more associated with the beginning of the website. An abrupt plummet occurred 13 August 2022 where average visits dropped from the mid 200s per day to less than 100. I think this latter drop was due to internet

Fig. 1 Timeline Daily Post Visits (23 Jan 1919 – 28 Dec 2023)



fatigue from the pandemic as most students returned to inclass attendance instead of online remote classes. Now this trend has persisted throughout 2023 with one notable outlier on 29 August 2023, where there were 6,353 visits in that one day.

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 low trend starting in August 2022 has also persisted throughout 2023 as shown in this display as well.

Percent Visits per Week Day. Using these normalized numbers, I tried to see if there was 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, I was considering 2 years of accumulated data from the start, but now I only show the last year's amount to eliminate the dominance of the beginning. I compare last year with this year in Fig. 3. There is a marked swapping of frequency of visits between Friday and Saturday for some reason. But the real outlier occurs on Tuesday, 29 August 2023, when the 6,353 views took place. This will skew the display until 29 August 2024.

Number of New Visitors per Day. Related to this

Fig. 2 Average Daily Visits per Post (Daily Total Visit Count/Cumulative Posts) (28 Dec 2023)

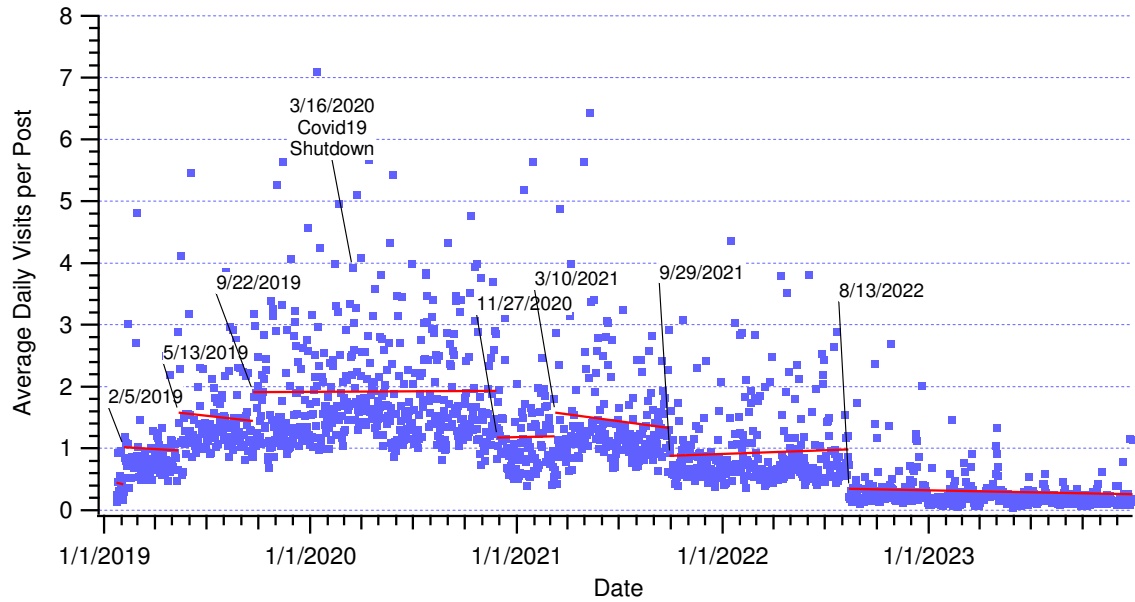
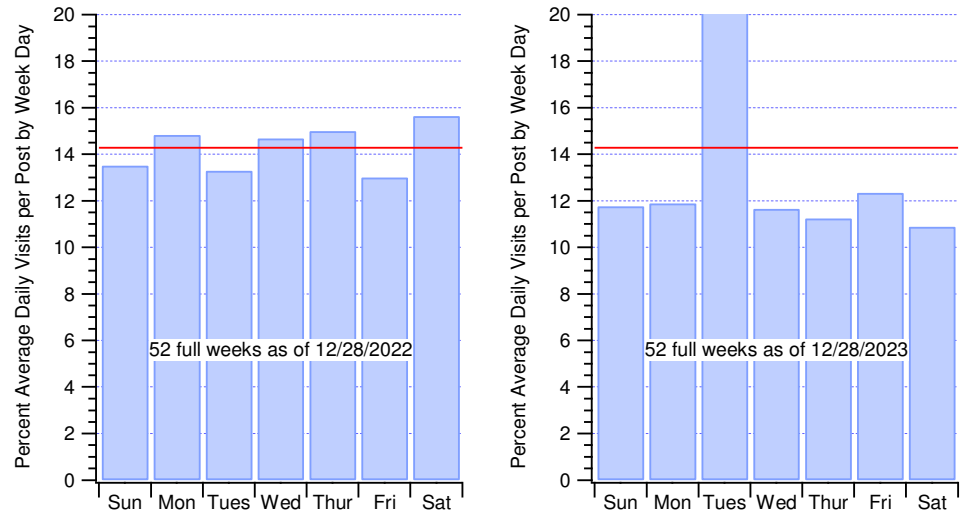
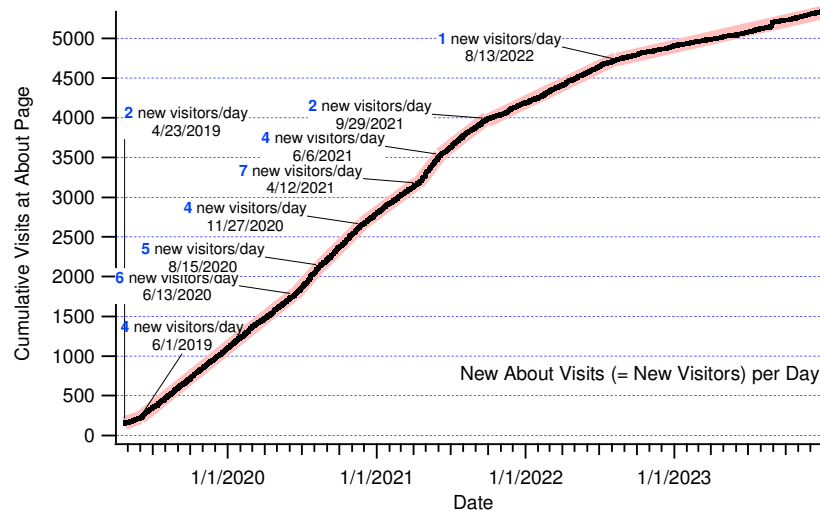


Fig. 3 Percent Visits per Week Day – 2022 v. 2023



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 initially 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

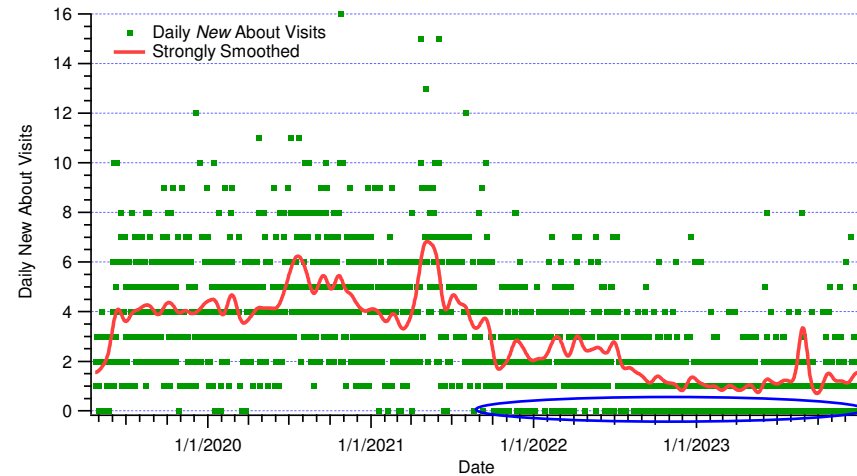
Fig. 4 Cumulative Number of About Visits (28 Dec 2023)



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.

There is a sudden drop in the 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. And then a precipitous drop occurred on 13 August 2022 to about one new visitor per day followed by longer stretches of no new visitors. And there it has stayed except for the unusual 45 new visitors 29 August 2023. Perhaps it was as a result of some type of math class that discovered the website.

Fig. 5 Daily New About Visits (28 Dec 2023)



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

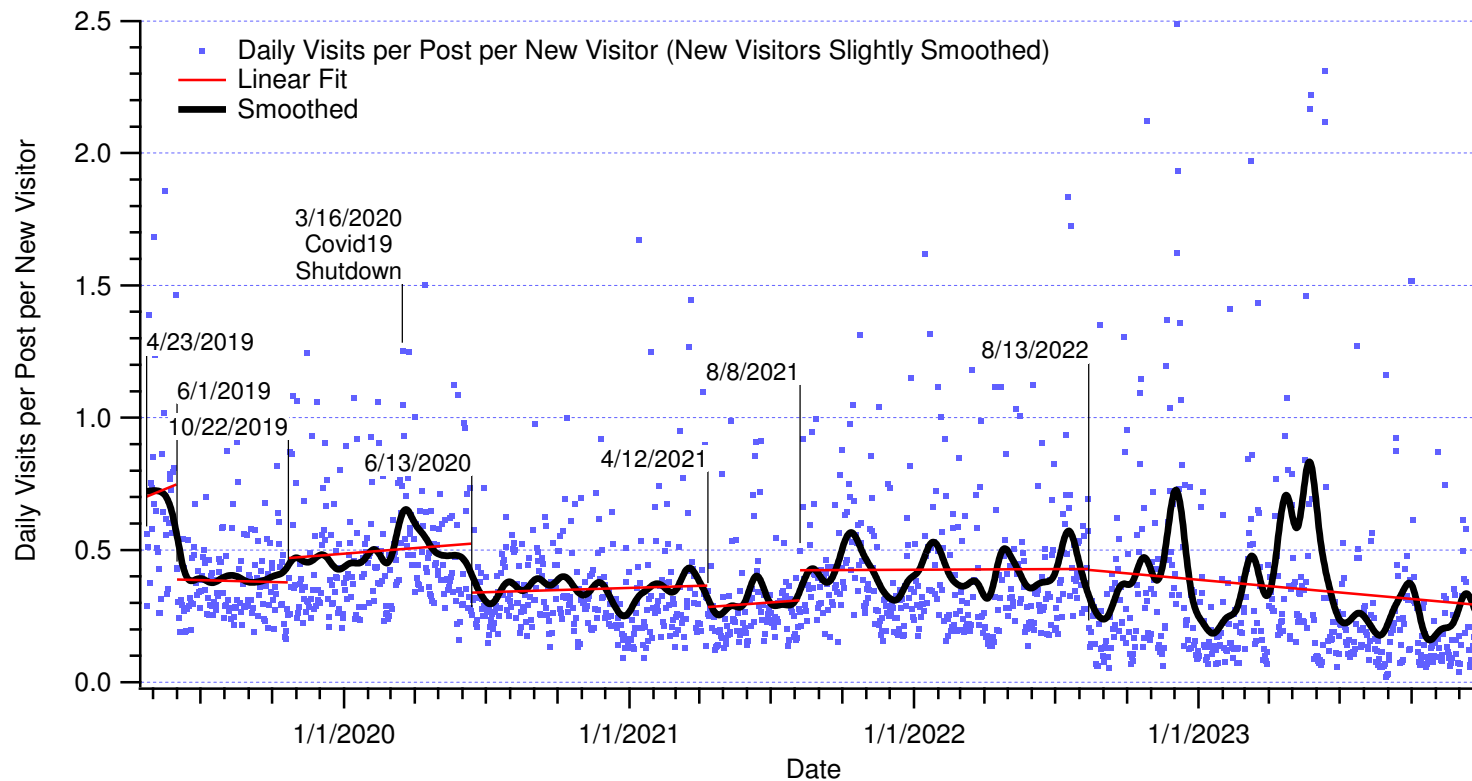
days, so they bring a locally heightened level of posts visited per day, and dividing by 0 would create an unrealistic anomaly.

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. This suggests the number of visits to posts is determined more by the number of new visitors than by older visitors returning to the site for updates.

There is a strange 3 month periodicity in the 2022 numbers that is a bit curious.

The large excursions starting on 13 August 2022 come from the small values for both posts visited (in the numerator) and new visitors (in the denominator). This means a small change in the numbers is a relatively large percentage change in the totals, so the ratios will oscillate from small to large.

Fig. 6 Daily Visits per Post per New Visitor (28 Dec 2023)
(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.

Generally the newer posts should hold more interest than the older ones, but interest in the old posts does not completely disappear, since the oldest currently show more than 1200 visits. But the dampened interest in the website from new visitors since 13 August 2022 is reflected in the more or less flat distribution in 2023.

See Fig. 9 regarding the sudden explosion of interest in the Ancestors and Bachet Weight Problems. 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. 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. Since interest in the website has fallen off, the recent posts do not show the heightened interest relative to the older posts that was the pattern up to now. So the fit is less to a power curve than a straight line, with diminished interest in posts off-setting the few new posts of high interest. 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 Falling Sound Problem.

Fig. 7 Most Recent Snapshot of Cumulative Post Visits (17 Dec 2023)

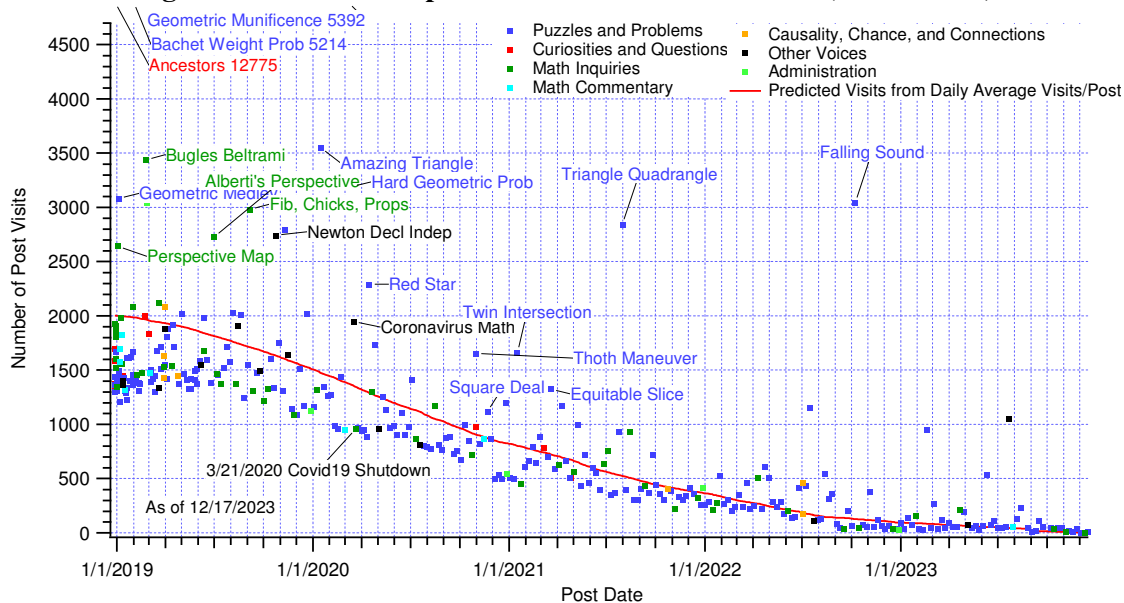


Fig. 8 Average Daily Post Visits Since Posting (17 Dec 2023) (Cumulative Post Visits / Days Since Posting)

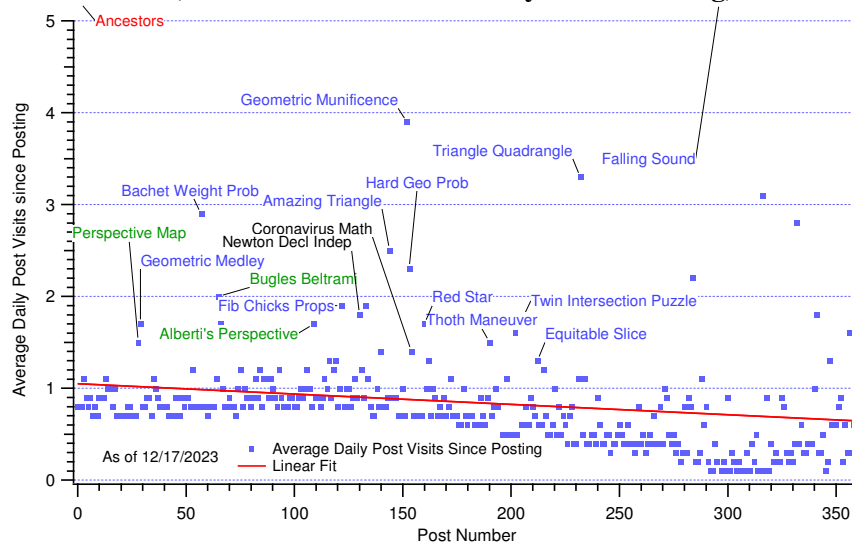
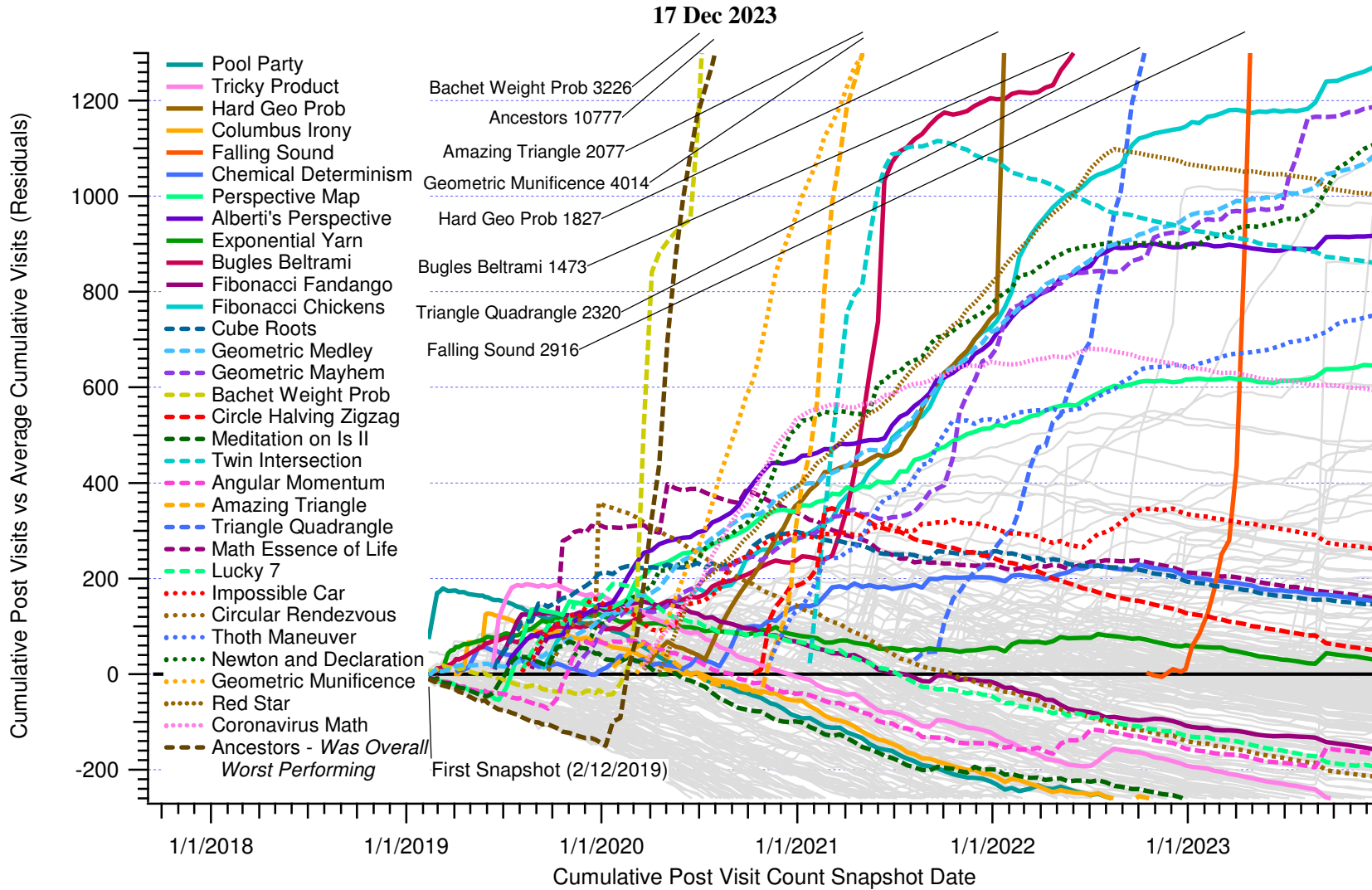


Fig. 9 Individual Cumulative Post Visit Timelines Relative to an Average Cumulative Post Visit Timeline (Zero Line)



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. Another post show “off the chart” growth, but from the very beginning:

Geometric Puzzle Munificence (3/7/2020)

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

Hard Geometric Problem (3/14/2020)

Geometric Puzzle Medley (1/4/2019)

Falling Sound Problem (10/8/2022)

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

Triangle Quadrangle Puzzle (7/31/2021)

Geometric Puzzle Mayhem (11/10/2019)

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

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

Perspective Map (1/2/2019)

Red Star (4/15/2020)

Straight and Narrow Problem (3/20/2019)

Chemical Determinism – Motor Proteins (4/1/2019)

I think much of the persistence of some of these top posts comes from the Top Fifteen 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.

I should mention a further surprise. Even though the Ancestors Problem has been garnering unusual visits in the past, in the hundreds each month, starting in October 2022 there was a sudden resurgence of interest amounting to almost 800 visits. Then in November and December the number exceeded 1000 per month. I have no idea why this occurred. Moreover, this increase in interest did not spread to any of the other posts. Maybe this was some sort of bot activity.

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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