HAT 3/7/18
WS: Predictable Change

Some sequences, although neither arithmetic nor geometric, still change by a predictable amount. Sometimes, a recursive equation may be obvious. Sometimes, an explicit equation may be obvious. Sometimes, nothing is obvious and we have to explore to reveal the pattern.

1) Finite Differences:

- $1,\ 4,\ 9,\ 16,\ \ldots$
- $1,\ 2,\ 5,\ 10,\ \ldots$
- $-1,\ 13,\ 49,\ 119,\ 235,\ 409,\ \ldots$

2) Odd/Even:

- $1,\ \frac{1}{3},\ \frac{1}{5},\ \frac{1}{7},\ \ldots$
- $\frac{3}{2},\ \frac{3}{4},\ \frac{1}{2},\ \frac{3}{8},\ \frac{3}{10},\ \ldots$

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3) Factorial:

- 1, 2, 6, 24, 120, …

4) Fibonacci/Lucas Numbers:

- 1, 1, 2, 3, 5, …
- $t_n = \frac{\sqrt{5}}{5}\left(\frac{1+\sqrt{5}}{2}\right)^n - \frac{\sqrt{5}}{5}\left(\frac{1-\sqrt{5}}{2}\right)^n$
- 2, 1, 3, 4, 7, 11, …

5) First Order Difference shows a Geometric Pattern:

- 3, 5, 9, 17, …
- $\begin{cases} t_1 = -9 \\ t_{n+1} = 2t_n + 8 \end{cases}$