Technology Review
Use of Microsoft Excel and the Fibonacci Sequence

Samuel L. Peoples, CST, MA-C

July 20, 2016

Microsoft Excel is a spreadsheet preparation program which allows for data organization, evaluation, and interpretation. Since 1985, the program has been available for students and professionals, with a wide reach of application and availability. As a part of the Microsoft Office package, it is typically included with most versions of Windows, but can be downloaded for little-to-no cost with proof of educational use. This program is quite useful in the teaching and application of algebraic skills, particularly through Excel's ability to define and evaluate functions which compare cells and act on their current or future state. In this exercise, the *Center for Technology and Teacher Education*[1] has provided information and guidance concerning the Fibonacci sequence and how it relates to algebraic thinking.

Students will call upon their skills in problem solving, pattern recognition, and formula development to solve the problem of: "A pair of newly born rabbits is brought into a confined place. This pair, and every later pair, begets one new pair every month, starting in their second month of age. How many pairs will there be after one, two, months, assuming that no deaths occur?" [2] Through the use of excel, embedded formulas, and trial and error, the students will be able to generate the Fibonacci sequence and explore the properties of the golden ratio (Φ)

The exercise not only allows for students to expand their algebraic skills and reasoning through the use of Microsoft Excel, but they are able to expand their abilities in the program through their knowledge of algebra and how functions interact. For example, in Figure 1, students are instructed to expand the month column from 12 months to 24 months. By selecting the items in the column and dragging the green square (circled in red) to iterate the problem as far as needed. Although simple in nature, the student would be able to understand that each cell n, having a cell n before it, is equal to $n+1$. The same can be said for the subsequent columns, where the students are asked to create a formula for the number of "Old Pairs of Rabbits." Through some exploration, the students would discover that instead of writing the equation by hand and placing their solutions into the cells, they would be able to type "=SUM(C2,B2)" into the cell B3, and follow the same process to apply the formula to the entire set of 24 months. By learning these processes, the students

[1] Fibonacci-Like Sequences and the Golden Ratio – http://goo.gl/wKZtko

[2] Vajda, S. (1989). Fibonacci Lucas Numbers, and the Golden Section. New York: Halsted Press, p. 9.

are not only able to explore their algebraic skills, but are also prompted to learn the scope of the program. This is especially useful for tedious and recursive functions which would take far too long to implement.

Following the population of the four columns, the students are instructed to create a line graph from the data in column D, referenced in Figure 2. Following the creation of the graph, the students are instructed to determine whether the graph is perfectly exponential through chart options and manipulation. By adding an exponential trend line and associated equations to the graph. Interpretation of the trend line from the graph can direct students to the conclusion that the Fibonacci sequence is, in fact, not perfectly exponential. As the students progress through the activity, further applications of their algebraic skills test their abilities with the program, such as the relationship between the ratios of the different iterations of the Fibonacci sequence to Φ. This relationship is displayed in Figure 3.

This exercise is beneficial in developing the students' algebraic and algorithmic thinking in its requirement to develop functions and graphs from data, as well as the guided assistance through the use of the program. The most beneficial aspect of using this technology is the ability to define and apply recursive functions from large sets of data, which would be tedious for the students if done by hand. By keeping the attention of the students, the activity allows them to feel engaged and proves to be quite entertaining. Building skills with different aspects of technology allows the students to use their skills in abstraction to apply them to unrelated problems in the future; while the activity presents itself with limited scope, the skills learned in this exercise stretch far beyond exponential functions and their relationships.

While Microsoft Excel is a beneficial tool for students and should be a part of every algebra teacher's arsenal of instruction tools, there are inherent constraints which distract the students from their learning. Excel is a very complex program and can be intimidating if there are not clear instructions. Because of this, there must be more attention devoted to the development of the activity, which takes time from other teaching opportunities. If the exercise guides the students too much, it becomes a chore; if the exercise has too little instruction, there will be a lack of confidence in the students.[3] There is also an important aspect of the program which could impede the learning of the topic at-hand, where students will reach solutions quickly and miss essential points from the

[3] Excel In the Classroom – http://goo.gl/uaoNQA

activity.

When weighing the reasons for and against using Microsoft Excel in the classroom, it is evident that the program provides more positive educational value to a student's learning than negative. While activities take more time for the teacher to develop, there are limitless applications which can be found online, and supplemented with lecture and other activities, Excel can be used to cement the skills and topics students need to excel in mathematics. Being such a ubiquitous and readily available program, it is easy to find pre-made applications and quickly add them to lesson plans. Through the various things that can be done with Excel, students are able to develop their skills in problem solving, pattern recognition, and formula development to better understand topics such as the Fibonacci sequence.

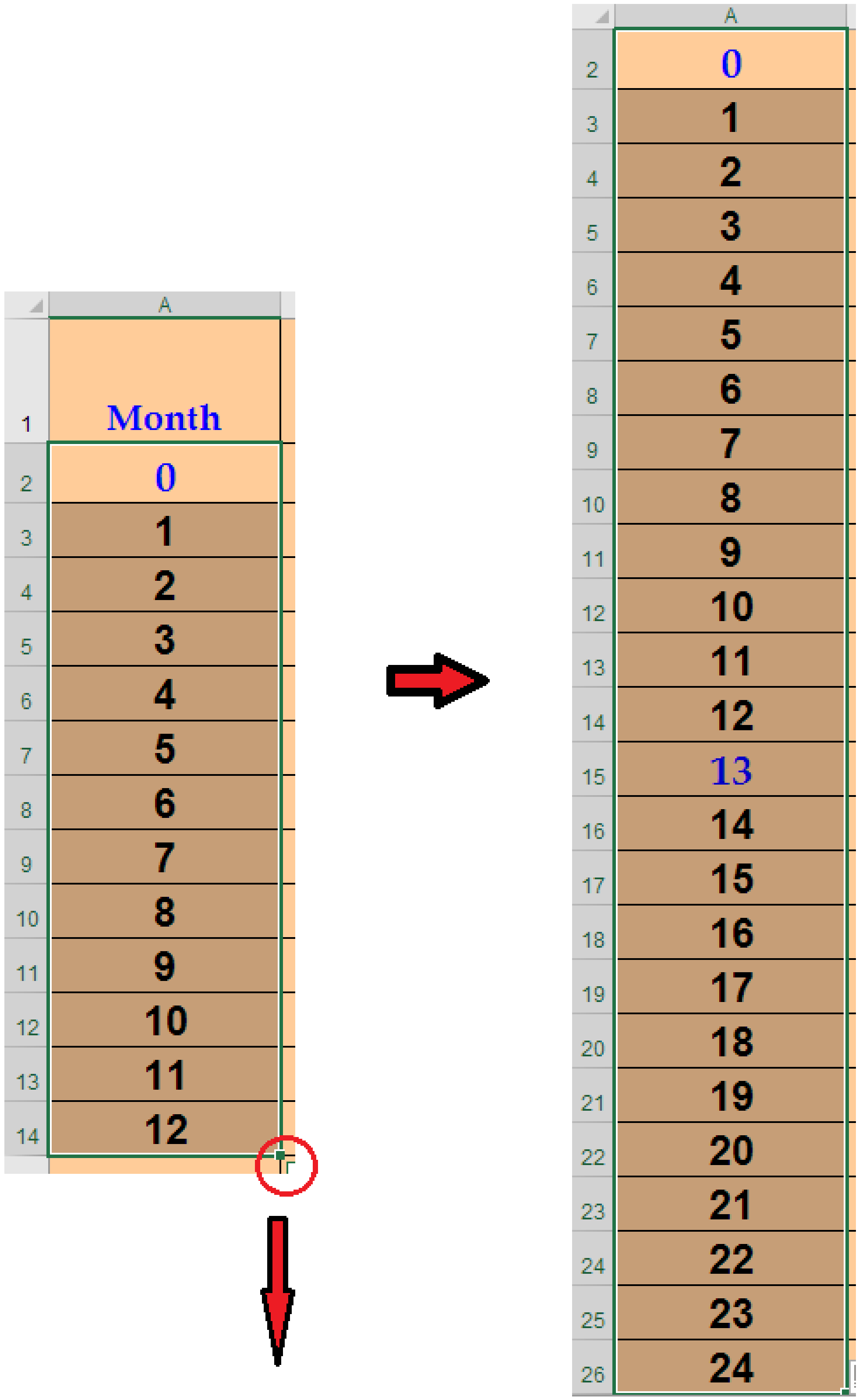


Figure 1: Iterative cell expansion.

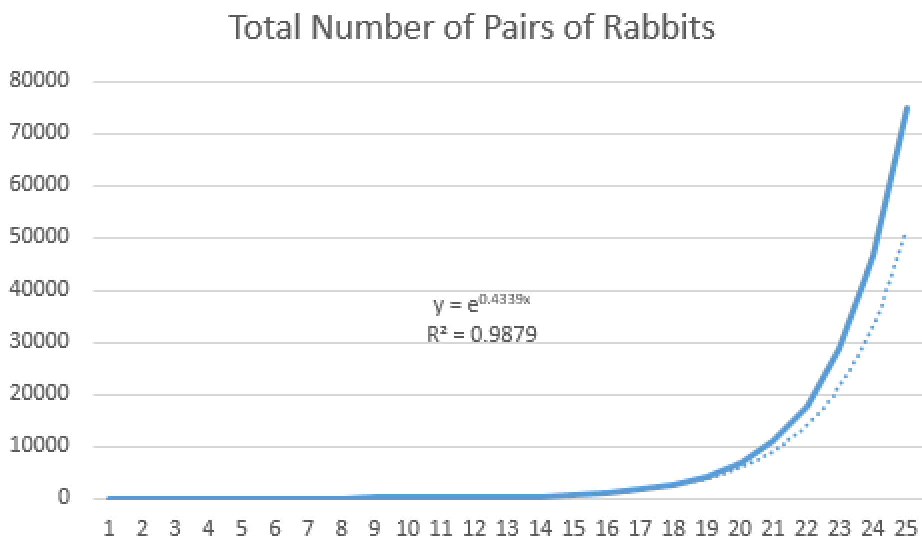
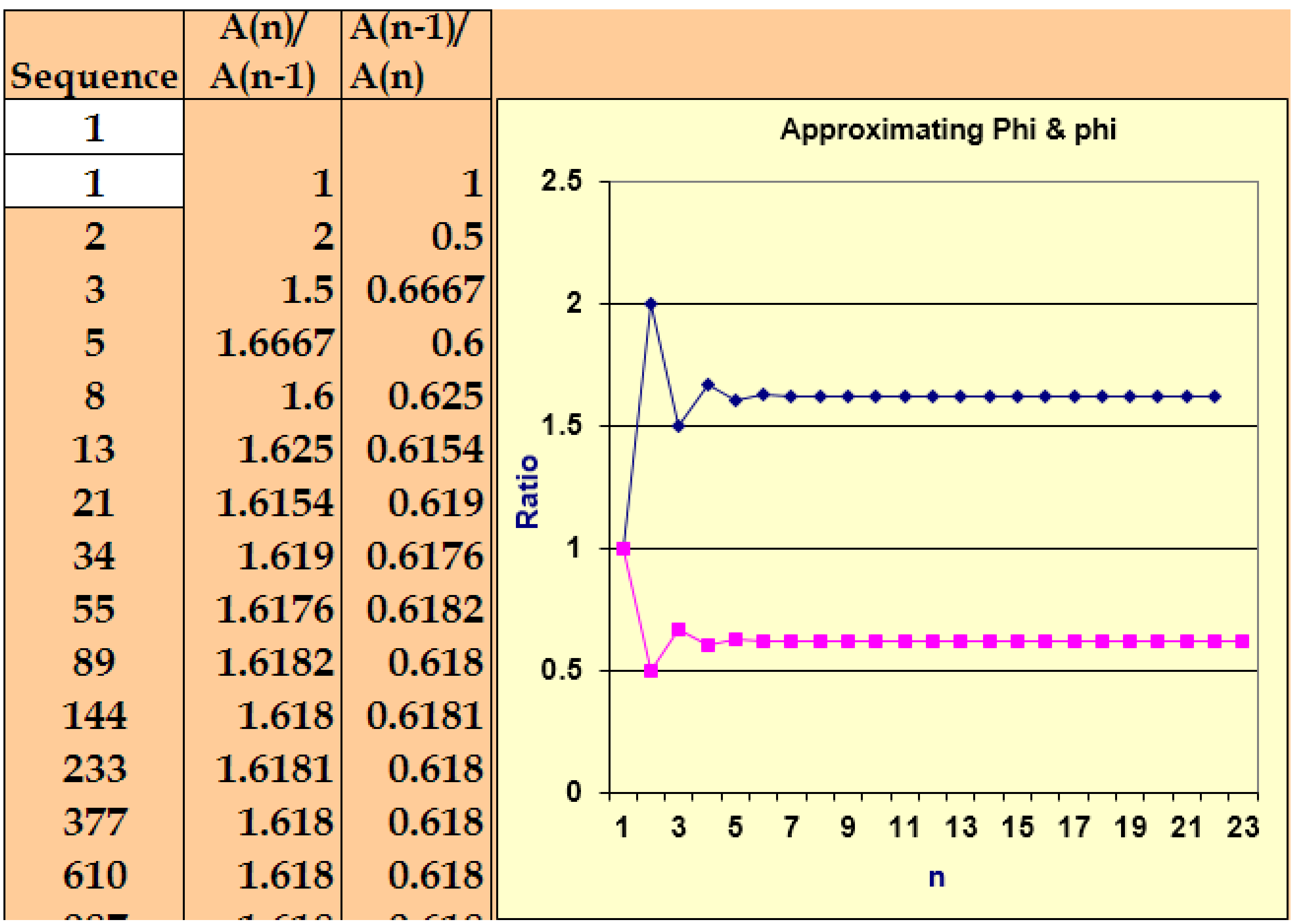


Figure 2: Line graph from column data.



Sequence	A(n)/ A(n-1)	A(n-1)/ A(n)
1		
1	1	1
2	2	0.5
3	1.5	0.6667
5	1.6667	0.6
8	1.6	0.625
13	1.625	0.6154
21	1.6154	0.619
34	1.619	0.6176
55	1.6176	0.6182
89	1.6182	0.618
144	1.618	0.6181
233	1.6181	0.618
377	1.618	0.618
610	1.618	0.618

Figure 3: Fibonacci sequence in relation to Φ and ϕ

This page intentionally left blank.