Kolmogorov's Question

Elaine Krajenke Ellison

Retired Mathematics Teacher

5739 Wilena Place

Sarasota, Florida 34238

www.mathematicalquilts.com

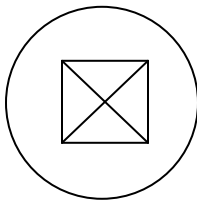E-mail: eellisonelaine@gmail.com

Abstract

An article in the April 2011 "Mathematics Teacher" sparked my interest to create the "Behold! Buttons" quilt. The mathematical quilt illustrates the 63 different four-hole button attachments to a shirt. According to the article, Andrei Nikolaevich Kolmogorov asked a relative at the age of five: how many ways can a four-hole button be sewn to a shirt?
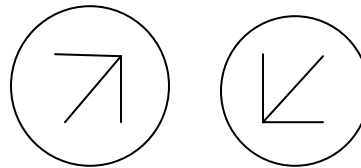
Introduction

In 1903, Andrei Kolmogorov was born in Tambov, Russian Empire. He lived until 1987 and passed away in Moscow, Soviet Union. Some historians believe that Andrei was the greatest Russian mathematician of the twentieth century. At an early age, Andrei began writing mathematical papers. As a teenager, his papers were printed in his school newspaper. His work at Moscow State University prepared him for significant contributions in many mathematical fields.

Exploring the Possibilities

The button here has four holes, any two of which can be connected with thread. As the figure below shows, the thread can make six distinct connections.

Figure 1: *Button with 6 thread networks*

Figure 2: *Two different network patterns*

Once a button has been sewn to the garment, it can no longer be rotated.

Combination Formula

We can use the combination formula to help us find all possible thread patterns. The number of combinations of n objects, taken r at a time, is written : $C(n,r) = \dfrac{n!}{(n-r)!r!}$ There is exactly one way to make the 6 connections: $C(6,6)=1$. There are 6 ways to omit one of the connections: $C(6,5)= 6$. There are 15 ways to omit two of the connections: $C(6,4)=15$. Of the 20 ways to omit 3 connections $C(6,3)=20$. Of the 15 ways to omit 4 of the connections we have $C(6,2)=15$. There are 6 ways to create exactly one connection: $C(6,1)=6$. Summing up the possibilities we have $1+6+15+20 +15+6= 63$

Figure 3: *Behold! Buttons* quilt

The size of the hand-sewn quilt is 58" by 69" and the materials used are 100% cotton. Layers of sheer fabric were used to construct each button. The pattern of the button networks begins with one 6 thread pattern. Following the only 6 thread pattern button are the six 5 thread pattern buttons. Then the fifteen 4 thread pattern buttons. The twenty 3 thread pattern buttons, fifteen 2 thread pattern buttons, and finally the six 1 thread pattern buttons.

References

[1] The Mathematics Teacher, April 2011, vol. 104, #8, page 606.