





Can you Cross the Bridge?

by Ndango Kutama

Once upon a time, a herd of elephants lived in the Elphi Kingdom. They were known for their unique memory and were envied by other animals. One day, while baby Kuda played hide and seek with the other baby elephants, he wandered around and reached the famous Time-Series Canyon.

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On the other side of the canyon stood three baby pandas, Casey, Salam, and Min. They were crying hysterically for their friend, Bunny, who was taken away by the Time-Series Canyon king for failing to complete the riddle. Pandas were known for clumsiness and eating. These baby pandas wanted to go on an adventure to eat different bamboo. The problem was, no panda had ever crossed the Time-Series Canyon, according to the history books of the animal kingdom, and these cubs were determined to become the first embarrassment of pandas to do it.

When Kuda saw the cubs crying, he said to them, "Hello, hello. My name is Kuda. What are your names?"

But Kuda's voice was drowned out by the cubs' hysterical cries. Kuda didn't give up. The baby elephant decided to trumpet a lullaby to comfort the baby pandas. "Hush, little baby, don't say a word. Mama's gonna buy you a mockingbird. And if that mockingbird...." sang Kuda.

The baby pandas heard the trumpet and stopped crying. They looked around for the trumpet's owner and saw a baby elephant standing near the edge of the canyon trumpeting the lullaby.

The baby pandas started to sing along with the baby elephant and when the lullaby ended, they cheered together.

"You are a good trumpeter. Who taught you to trumpet?" asked Salam. Kuda responded shyly and said, "Mother taught me".

"Can you teach me how to trumpet?" asked Casey.

Before Kuda could respond, they heard a piercing shriek, making the cubs move back from the canyon's edge, bringing them back to reality.

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"What are you?" asked Min.

Before Kuda could respond, Casey chimed in, "Can you cross the bridge? Does your kingdom have bamboo? What types of bamboo do you have?"

"I am an elephant, and yes, I can cross the bridge," Kuda answered proudly.

The baby pandas were beyond cheerful. They had finally met an animal that had crossed the canyon, and made a new friend. They were now more determined than ever to save their friend Bunny, and cross the canyon to continue on their bamboo adventure.

The Time-Series Canyon was ruled by King Arima(p,d,q). This canyon comprised four elements: fire; water; earth; and air. To cross the canyon, animals had to solve a riddle. This riddle was used to identify and group the subjects of King Arima(p,d,q). Once animals successfully solved the riddle, they could cross the canyon anytime.



Eager to see what their new friend could do, the baby pandas asked Kuda to cross the canyon, which Kuda did. Kuda crossed the canyon in a matter of seconds, shocking the baby pandas. They were surprised by how fast and easy it was for their new friend to cross the canyon, which made the clumsy pandas more determined to cross it. All they could see were bamboo rainbows and bamboo in different colours and shapes. They started to drool, but sadly, the moment was interrupted by Kuda.

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“So, why were you three crying? What happened?” asked Kuda.

The three cubs looked at each other with big teary eyes and pointed towards the canyon with their paws.

Kuda was confused, so Casey decided to tell Kuda their story. It started when they met Lira, the snake, who told them about Bamboo Paradise. When they asked Lira to accompany them, Lira gave them directions instead.

After getting the directions, they left a note for their guardians and started on their journey. Travelling was difficult for them as they were used to eating and sleeping, but paradise became their motivation. Along the journey, Foxy, the fox, joined them. As she was concerned about the cubs’ safety, she helped them pass the Pride Lands and Kuvuki Land (the land of hyenas). Thereafter, they went their separate ways. Their adventure was filled with laughter, tears, and pain.

Everything came to a halt when they reached the canyon, and King Arima(p,d,q) gave them a riddle which Bunny volunteered to do. If they failed, Bunny would hand himself to the king. The riddle was an equation to be solved with the aid of the kingdom's most sacred book, written by the smartest orangutan, Johanesty. The book had notes that could be consulted to help solve the riddle. They worked on solving the riddle for seven days and seven nights, but due to exhaustion and change in diet, the baby pandas couldn't help Bunny with the riddle.

And so, the king took Bunny from them. After Casey narrated the story, Kuda asked to see the riddle and the notes, which Salam had eaten out of anger.

Seeing that they no longer had the riddle, Kuda encouraged them to ask the king for their friend and a new riddle. The king gave them a riddle, and Kuda was allowed to help them as long as they solved the riddle by midnight. The baby pandas were relieved, but worried about the deadline as they could barely do the first one. This time it was different; they had Kuda by their side, eager to help them reunite with their friend and join them on their journey to Bamboo Paradise. The curious baby elephant asked the king for extra copies of the sacred book which was provided to them.

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Kuda opened the riddle, which read as follows: "Identify parsimonious ARIMA(p,d,q) model for the following time-series process by determining the values of p , d , and q of the equation:

$$Z_t = Z_{t-1} - 0.25Z_{t-2} + a_t + 0.5a_{t-2}."$$

Kuda also noticed a reference that was given next to the riddle. The baby elephant asked the three baby pandas to go to the referenced section, which took longer than Kuda expected, especially with each baby panda holding its own copy. After a few hours, Min found the referenced section.

According to the referenced section, to find the p , d , and q values, they would have to check if the given equation had d unit roots by finding the first difference, thereby solving the characteristic equation of the first difference to determine if it was stationary or not. If it was stationary, the equation had no d unit root, but if it was not, then there

was a d unit root. To determine stationarity, they would have to check if the roots of the characteristic equation were all greater than one in absolute value. If they were, then $\{Z_t\}$ was stationary. Kuda already knew how to determine the values of p and q , which were easy to spot from the given equation.

Kuda determined that $p=2$ and $q=1$. The baby cubs worked together to determine the value of $d=0$. The thought of reuniting with Bunny motivated them to use their dormant intelligence. They concluded that the answer to the riddle was ARIMA(2,0,1).

The king presented the answer to Johanesty, who informed the king that the answer to the riddle was correct. The king released the baby panda, and Bunny was finally reunited with the other cubs. A decree was issued across the animal kingdom that three baby pandas, with the help of a baby elephant, had solved the name of King Arima(p,d,q), now known as King Arima(2,0,1).

