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Iannis Xenakis's *Achorripsis*: The Matrix Game by Linda M. Arsenault

In this paper, Arsenault discusses about the creative game strategies employed by Iannis Xenakis in his composition *Achorripsis*. *Achorripsis* is a score for 21 instruments in which each musical element, such as the overall form, is stochastically determined. The author specifically focuses on the mathematical strategies involved in using Poisson's law to create the game matrix of the formal structure of the piece.

The essence of the piece *Achorripsis* is the variation of sounds' densities, called "clouds of sounds" by Xenakis. Xenakis used the Poisson distribution to determine the matrix for the distribution of clouds of sounds during a particular period of time. First Xenakis arbitrarily chose 0.6 for the value of the rate parameter λ and generated the probabilities of events, such as zero, single, double, triple, and quadruple events. He arbitrarily decided a matrix containing 196 cells (28 columns by 7 rows) as the structure for the piece. Multiplying the probabilities by the number of cells obtains the total number of each event.

Xenakis reapplied the Poisson's law to distribute the events among the columns and rows respectively in accordance with the mean densities. He divided the total number of events by the total number of columns/rows to get a new rate parameter λ for each type of events. Substituting the rate parameter with the new generated value in the Poisson formula produces the probability distribution for each type of events in columns/rows. The final number of occurrences for each type of events is obtained by rounding and manually manipulating the multiplication of the probabilities and the number of columns/rows.

Following the above steps, Arsenault found that the calculation results are different from the ones reported by Xenakis. Without step-by-step demonstration of Xenakis's calculation, Arsenault proposed two possible manipulations to make the total number of events equal to the total number of cells. Arsenault indicated that the altered version of the distribution of events no longer resembles the Poisson distribution. She gave a hypothetical explanation for the inconsistency: "Xenakis made artistic decisions motivated by a preconceived notion of the densities for the music he had in mind."

The game matrix supplies three requirements: the number of columns, the number of rows, and the numbers in the overall distribution of events. However, there is no mechanism for distributing the events into specific columns or rows, leaving composers a great deal of freedom. Xenakis established the duration of composition at 7 minutes, arranged 7 distinct timbres for 21 instruments, placed zero events evenly to divide the piece into a tripartite structure.

I am very impressed with the careful arrangement of events of the score in accordance to the probability distribution in Poisson process. The idea of applying Poisson distribution seems unintuitive to me in the beginning but makes more sense as I read through the paper. The distribution contributes to the contrast in the score with the property that dense events happen less. But the mechanism only provides the occurrence of events; many details such as pitch, harmony, and instrument arrangement are left for the sense of aesthetic. I am not familiar with atonal music, therefore, listening to the recording of *Achorripsis* does not help me much on judging the effectiveness of the mathematical strategies.