Gérard Cohen's consultation on the scientific validity of Professor N. ALON's consultation: "Poker, Chance and Skill"

I. INTRODUCING GERARD COHEN

Gérard Cohen was born in PARIS in 1951 on the 25th of August. His full Curriculum Vitae is featured in Appendix 1.

He holds a post-graduate diploma from the National School of Telecommunication (ENST), is a state qualified doctor in Science (Mathematics) and a lecturer at the ENST.

Apart from the ENST, he taught in many institutions, in particular at the University of Paris, in the 6th arrondissement to post-graduate pre-doctoral students, as well as in mixed post-graduate lectures, X, in Paris in the 6th arrondissement and in the ENST.

He heads up the "Mathematics for IT and Networks" team comprising of 10 lecturers-researchers and 6 doctorate students.

The subjects he teaches are mainly the following:

- Theory of information and probabilities
- Encoding, Complexity and Cryptography

He's a member of various scientific societies, including the French Mathematical Society, the American Mathematical Society, the Who's who in the World and he's a Senior member of the IEEE

Gérard Cohen is the president and founder of the IEEE chapter on Information Theory.

Expert in encoding, information theory, complexity and cryptography he is the author or co-author of 3 books, of over 100 publications in international journals and he has directed around fifteen theses.
A complete list of his work can be found in appendix 1.

The large number of industrial contracts and of consultations (SNCF, Gemplus, Canal plus, Sagem...) as well as the amount of public financing (CNRS, bi-national projects) he has been entrusted with and his participation in the European Projects of Excellence (see Appendix 1) are all testimonials of his expertise in 'error detection

and correction' and cryptography.

II. THE QUESTION:

The question posed is the following: what is the scientific validity of the conclusions drawn in Professor N. Alon's consultation on the subject of "Poker, Chance and Skills"?

This consultation, presented in its entirety in Appendix 2, concludes in particular the following:

> "*By analyzing simplified versions of poker we have seen that although like essentially almost any other game there is some influence of chance in poker, the game is predominantly a game of skill.*"

III. The expert's view

If Poker was a game of chance only, a beginner or a computer would play just as well as a champion (i.e. there would not be any champions...). There is therefore undeniably **a part** of know-how in the game.

The challenge here is to show that Poker is **primarily** a game of skill.

However there is no mathematical theory or even quantification of the notion of skill. Professor Alon therefore has to call upon a subtle blend of theorems and arguments to support his demonstration.

In particular, in order to be able to formalise the problem, N. Alon makes use of simplified yet fairly realistic versions so that 'continuity' arguments play a role and the real problem 'inherits' the properties so obtained.

The game of poker being of nil sum (what is won by some is lost by others, except for the various fees), the relevant criterion adopted is that of **the hope of positive gain**.

Note however that the aim of the study differs from those of the usual Game Theory

where the best strategy is sought in the context of optimal game. Here we want to demonstrate the impact of **a player's superior skill on his expected winnings.** After a brief description of the main version of the game, a few calculations of hand probability are carried out. Already at this stage, the influence of the player's ingenuity is shown: probability calculations and hand ranking, although basic, cannot be done in real time by a human being; the skill here consists in estimating one's position with a blend of estimation and intuition (as a Chess champion would). At this stage, superior calculation methods such as those done by a computer could still substitute this skill.

Then begins the demonstration itself, based on simple variations, of the **importance of know-how, as opposed to not-only chance but also simple memory or the ability to make calculations.**

Initially we estimate the average advantages in rounds involving two opponents of the most skilled player 'A' over the other player 'B' (propositions 4.1 and 4.2). In this scenario, B is "one strategy behind" of A and A (Alice) is aware of it.

In the first case study, B (Bob) plays in a random manner and Alice (knowing it) maximises her winnings prospects: proposition 4.1 determines this maximum value as well as the distribution in relation to this average.

In the second case study, Bob has adapted and plays in the same way as Alice did in the previous variant; there again, Alice's optimal strategy is calculated in proposition 4.2 where the winnings average and dispersion are obtained.

However, in accordance with intuition, A's average winnings reduce as both players progress, based on the realistic assumption that Bob is always one strategy behind from Alice: in both the first two specific examples, the standard average winnings are initially worth 1/8 (instance 4.1), then they decrease to 1/16 (instance 4.2); in order to prevent the winnings from becoming nil, A has to **bluff**.

Later the study broadens to several opponents. The adopted model, legitimate since the purpose is to demonstrate the influence of skill, assumes that A is the only expert and that the other opponents play randomly. The analysis carried out in 4.4 shows that A's strategy must adapt to the number of players (by betting less often and with a hand that is stronger as this number increases) and it quantifies numerically this adaptation: the probability of A betting thus decreases by 1/2 with 2 players (A and B), by 0.465 with 3 players and by 0.315 for 10 players.

Then a demonstration is made (in section 4.4) that the skilled player must take into account in his or her strategy the position and the order of players around the table. This is still the analysis of a simplified version but in which the notion of compulsory betting is integrated. In the numerical variant chosen by the author for illustration purposes, which is easily adaptable, instance 4.3 shows the hand minimum value to bet as well as the expected winnings and their distribution.

In addition, making use of the Central Limit Theorem (Law of Large Numbers), Nogal Alon provides an analysis much more subtle than the simple calculation of expected winnings: providing a sufficient number of games is played, a skilled player's winnings will follow the trend of normal law of which moments can be calculated (average, but also variance, etc...). This means that expected winnings can be precisely measured thanks to the Normal law distribution function. The numerical convergence based on the number of played rounds is quick; it is thus possible to estimate precisely, not only A's expected winnings but also B's probability of winning, the probability of A's maximum winnings being a certain amount in n rounds etc...

Finally a few observations convincingly conclude that the real game, much more complex, requires even more know-how.

My conclusion is that I confirm the validity of Professor Alon's demonstration:

Skill has a predominant part to play in Poker.

Prof. Gérard Cohen

IV. APPENDICES

APPENDIX 1: CURRICULUM VITAE AND LIST OF GÉRARD COHEN'S PUBLICATIONS

APPENDIX 2: N. ALON'S CONSULTATION: "POKER, CHANCE AND SKILL"