

**Reflection of the mathematical dimension
of gambling in iGaming online content: A qualitative analysis
- Fifth technical report -**

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The current technical report presents the partial results of the quantitative analysis of the research project, after the review of 247 gambling websites. It is focused on and discusses the usage of the math terms specific to gambling in the reviewed sample.

The ethics of gambling submit to the more general ethics of commerce, as the bets associated with games of chance are still commercial products (services) offered to customers at a price. The mathematical description of the games and some mathematical aspects of gambling also fall within the customer-protection dimension of gambling, as gamblers should be informed about the games they play as well as the risks associated with gambling. This is why the adequate usage of the gambling-math terms and their linguistic context is of major importance for the presentation and advertising of gambling as a product compliant with the ethics of commerce.

In particular, the fifth technical report discusses the usage of math terms associated with the game of slots, as found in the reviewed sample.

Introduction

Mathematics is strongly connected to gambling through the mathematical models underlying any game of chance. Mathematics is reflected not only in games' design/characteristics and their outcomes, but also in gamblers' perception and knowledge of the mathematics-related facts of gambling – which influence their gambling behavior.

The math-indispensability principle (Bărboianu, 2013) applies not only in problem-gambling research, but also in the gambling industry. The structural, informative, strategic, psychological, pathological, and ethical aspects of gambling have been identified to be grounded in the mathematics of games and gambling (Griffiths, 1993; Bărboianu 2014, 2015; Turner & Hobay, 2004; Harrigan, 2009, and others).

Gambling cognitive distortions, language, and miscommunication

Gambling-specific cognitive distortions (in the form of misconceptions, misunderstandings, reasoning fallacies, biases, false or irrational beliefs, or illusions, alone or mixed) are believed to be an important cause of the development of problem gambling and are considered as major risk factors (Lambros & Delfabbro, 2007; Leonard & Williams, 2016, and others). We have analyzed these cognitive distortions in relation to the mathematical dimension of gambling and found that most of them are mathematically related (Bărboianu, 2022, pp. 219-221).

An important element that shapes and influences the aspects of gambling mentioned above, especially cognitive distortions, is language. The language of gambling can be intentionally or innocently misleading, confusing or conflicting, largely due to the mathematical nature of the essential concepts governing gambling, but also to the nature of language itself. The language of gambling unavoidably uses mathematical and mathematically-related terms and as such is a mixed language and therefore predisposed to semantic conflicts. This language may aim toward descriptions of the games, of their associated strategies, for communication between gamblers and between gamblers and experts, and to express any observations or research results in regard to this phenomenon. The fact that some specialized terms belong or are tightly related to probability theory accounts for their conflicting potential in the gambling language, since the concepts of probability theory are sensitive to interpretation, despite their mathematical nature (Bărboianu, 2022, pp. 203-218).

The problematic gambling language manifests in the activity spheres of developers, operators, gambling communities, information providers, experts (including problem-gambling experts), and gamblers' relationships with these people. This language affects the descriptions of games and gambling that the players actually use to become informed about the phenomenon; also affected are the communication between gamblers, and between gamblers and people from the gambling industry or experts as well as gamblers' own conceptual judgments related to gambling.

Goals and outcomes of the study

In this theoretical framework, research is able to derive concrete norms and criteria to adequately reflect the mathematical dimension of gambling in the communication and texts associated with the gambling industry. These norms and criteria of adequacy will be further communicated to policy and decision makers in both governmental and private sectors, with the recommendation for implementation.

Our study aims to evaluate qualitatively the reflection of the mathematical dimension of gambling in the content of gambling websites. This analysis is necessary in order to have an objective and concrete image of the actual state of this matter in the online industry and of the challenges that such research and application would face in the real world of gambling.

A minimum number of 120 gambling websites will be reviewed annually for their content in that respect. A statistical analysis will record the presence of the mathematical dimension of gambling and its forms in the content of participating websites, and a qualitative research will analyze and assess the quality of the content with respect to that dimension.

Methods and technical description of the instruments

The current study is a combination of quantitative and qualitative analysis, in which the latter is predominant and is given the central role.

The participants in the study (gambling websites, through their webmasters) were recruited through online advertising and direct invitations. Given the focus on the qualitative aspect of the study, the sample is not representative for the entire population. Besides, representativeness cannot be established with respect to the specificity of the population (gambling websites) and of the targets of the study.

The criteria of eligibility for participation that we have applied are:

- not having legally prohibited content or advertising;
- meeting the gambling legal requirements;
- having informative content besides the games and games' rules
- being fully operational and navigable.

The quantitative analysis will use basic descriptive-statistics methods, summarizing the data recorded from the sample by standard statistical indicators, with the following main specific variables:

v_1 - the presence of structural descriptions of the games in parametric terms (valued yes/no);

v_2 - the presence of informative sections ('How to' articles, blogs, guides) (valued yes/no);

v_3 - the presence of sections dedicated to odds/probability/math (valued yes/no);

v_4 - the usage of essential math terms specific to gambling (odds/probability, expectation, average/mean, etc.) (valued yes/no);

v_5 - the presence of the definitions of the math terms used (valued yes/no);

v_6 - the correctness of the math definitions used (valued on a scale from 0 to 5)

v_7 - the presence of game strategy topics (valued yes/no);

v_8 - the presence of math-based game strategy topics where applicable (using notions of probability theory, statistics, and game theory) (valued yes/no);

v_9 - the presence of systematic-learning or advanced content of gambling math (lessons, academy-style sections, in-depth guides, etc.) (valued yes/no);

v_{10} - the mentioning of author for math-related articles (valued yes/no);

v_{11} - the match between the math-related articles and their authors' declared expertise (valued on a scale from 0 to 3);

v_{12} - in-text presence of awareness on possible misconceptions, fallacies, and irrational beliefs in regard to gambling (valued yes/no);

v_{13} - the correlation of the above awareness with the mathematical aspects of gambling (valued on a scale from 0 to 3).

The values are conditional on each other as follows:

v_3, v_7, v_9 conditional on v_2 ; v_5 conditional on v_4 ; v_6 conditional on v_5 ; v_8 conditional on v_7 ; v_{11} conditional on v_{10} ; v_{13} conditional on v_{12} .

The qualitative analysis will use as methods discourse analysis, content analysis, thematic analysis, conceptual interpretation, semantic analysis, doubt about sense, and analysis of arguments. It will have a strong component of linguistic-conceptual-logical analysis, targeting the following main elements:

- 1 - the usage of terms with non-uniform semantics;

- 2 - the contextual usage of math terms;
- 3 - the conceptual linkages relative to the relevance for the topic;
- 4 - the soundness of arguments based on applied math;
- 5 - the association between game strategy and the concepts of probability theory and game theory;
- 6 - the presence and contextual impact of “mathematically prohibited” or misleading terms (such as ‘winning strategy’, ‘how to win’, etc.).

Although the qualitative analysis is independent of the quantitative one, correlations will be made between the conclusions of the former and the variables of the latter.

Representation of the mathematical dimension of gambling may or may not be adequate in the content of gambling websites. The main goal of the qualitative analysis is to establish the disciplinary areas, as well as their individual roles, which can contribute to the theoretical framework that will derive the norms and criteria for such adequacy in the content of the websites and of the gambling communication. These disciplinary areas entitled for involvement include mathematics, psychology, linguistics, philosophy of language, epistemology, and philosophy of mathematics.

Content and roles of the technical reports

Monthly technical reports describing the partial results of the qualitative analysis will be published on academic channels, preceding the main publication at the end of the study.

Each technical report will cover the review and recording of data from ten websites, which are nominated in the section titled *Appendix*, along with brief descriptions from their owners.

We found such technical reports necessary, first because the current study is atypical in what concerns the statistical analysis and the qualitative analysis, as well as the objects under investigation. Therefore, the main role of the technical reports is to detect and define any methodological and technical difficulties encountered during this study and any challenges they may pose, for them to be analyzed and surmounted in both the continuation of the current study and any future similar research.

Besides presenting these difficulties and challenges, the technical reports will also contain unpredicted observations regarding the analyzed content that might require the revision or change of the methods and instruments used.

The results of the technical reports will be gathered, and general conclusions will be drawn in the main publication.

Observations, partial statistics, and conclusions from the review of the current sample

Within the quantitative analysis, 247 gambling websites have been reviewed during the period January 2023-January 2024; the collected data consisted of values assigned to the variables v_1 to v_{13} , defined in the section titled *Methods and technical description of the instruments*.

The breakdown of the studied sample by type of gambling website (per the taxonomy defined in the technical report no. 4) is as follows:

- 20.68% gambling portals
- 5.17% casino operators (of which 1.72% affiliate-program websites)
- 72.29% casino affiliates
- 1.86% other gambling sites

As discussed in the previous reports, sampling was random in the sense that no “representativeness” was defined for the statistical population, and the methods of accessing the sites were customary web navigation and responses to owners’ requests as the result of advertising the project.

We will present here only the partial statistics for the variables directly measuring the reflection of the mathematical dimension of gambling in websites’ content (v_1 , v_3 , v_4 , v_5 , v_6 , v_8 , v_{10} , and v_{13}).

v_1 : 1.72% of the sites had in their content structural descriptions of the games in parametric terms. (Those were sites dedicated exclusively to the math of gambling, focused on blackjack, and slots design; no other category of gambling sites had such content).

v_3 : 18.64% of the sites had sections dedicated to odds/probability/math.

v_4 : 32.20% of the sites used essential math terms specific to gambling (odds/probability, expectation, average/mean, etc.) The variable took value 1 for the usage of at least one term, regardless of the extent to which the terms are further defined or explained and regardless of the adequacy of the usage. Of these sites:

v_5 : 36.84% included the definitions of the math terms used. Of these sites:

v_6 : 71.42% displayed entirely correct definitions.

v_8 : 15.25% of the sites had sections with math-based game strategy topics.

v_{13} : 81.81% of the sites having sections with awareness on possible misconceptions, fallacies, and irrational beliefs in regard to gambling (counted by variable v_{12}) correlated this awareness with the mathematical aspects of gambling.

The general usage of the math terms specific to gambling, per the reviewed sample, is justly qualified as poor. Although 32.20% (v_4) may appear as a high percentage, we should not ignore that such terms are also present in the ordinary gambling language, and for the adequate understanding and application of them, a mathematical context is required. However, this context is lacking for most of the websites using the terms. If we apply the v_5 percentage to that 32.20%, we find that actually 11.86% of the reviewed sites included definitions for the math terms; moreover, if we further apply the v_6 percentage, only 8.47% of the reviewed sites presented correct definitions. This number reflects – among other conclusions – a low interest of the managers to present mathematical descriptions of the games they advertise, and this conclusion is supported by the values of statistics of variable v_1 : only 1.72% of the sites had in their content structural descriptions of the games in parametric terms, which is required as a prerequisite for the mathematical description of a game.

The simple mention of math terms associated with gambling in a gambling discourse or presentation has no value for their understanding nor for an adequate reflection of the mathematical dimension of gambling except when a mathematical context is preserved and properly described for the readers.

As found in past theoretical research (Bărboianu, 2019; 2022), not only the understanding of the mathematical notions of gambling (as formal mathematics) is needed for avoiding

the classical gambling misconceptions and fallacies, but also an adequate application and interpretation of those notions in the real world of gambling. This is why the context required for such notions to be presented adequately is both mathematical and epistemic, going beyond the formal definitions and encompassing application and interpretation.

The ethics of gambling submit to the more general ethics of commerce, as the bets associated with games of chance are still commercial products (services) offered to customers at a price. This price is actually the difference between the true odds (probability of winning a bet) and payout odds (what the house offers for a win).

The mathematical description of the games and some mathematical aspects of gambling also fall within the customer-protection dimension of gambling, as gamblers should be informed about the games they play as well as the risks associated with gambling. However, both the expectations and the risk of cognitive distortions in gambling are describable in mathematical terms. This is why the adequate usage of the gambling-math terms and their linguistic context is of major importance for the presentation and advertising of gambling as a product compliant with the ethics of commerce.

In the reviewed sample, most of the websites using math terms specific to gambling were those focused on the game of slots. The terms included RTP (return to player), volatility, and odds. The RTP was seen as the main statistical indicator of a game of slots (and indeed it is, as the parametric configuration of the slot games is kept secret by their producers, and therefore the probabilities of the winning combinations cannot be computed). While friendly precise definitions for the RTP were provided, we found only two sites insisting on the mathematical nature of this notion, namely that of statistical average and its interpretation.

Since the lack of understanding the RTP in its statistical nature is responsible for the common misconceptions, misinterpretations, and fallacies among slot players regarding the RTP (Beresford & Blaszczynski, 2020; Collins et. al, 2014; Harrigan, 2007), the simple mention of the notion without its adequate context is itself misleading.

The RTP example is just illustrative for the poor presentation of the gambling-math notions in online content; furthermore, the principles above apply to all such notions, especially the core notions, those of probability and expected value.

While adequate content with respect to gambling-math notions requires expert writers (and in our statistical analysis the involvement of expert authors is counted by variables v_{10} and v_{11}), the discussion can be extended as to what extent such content is accessible for the gambling websites and to what extent their content policy aligns with the responsible-gambling norms in regard to playing informed.

Regarding accessibility of such expert content, it is envisioned that special programs developed by legal-gambling authorities, problem-gambling institutions, and/or gambling-research centers will provide such content and enforce its acquisition by the gambling websites.

Appendix – Selective list of reviewed websites

meneercasino.com (reviewed in February 2024)

Dutch online casino resource offering reviews, tips, and news, written by experts and professional journalists. It emphasizes safe and legal gambling practices, catering specifically to players in the Netherlands.

kingcasino.it (reviewed in February 2024)

Italian online casino resource highlighting game selection advice and reviews for an optimal gaming experience.

wincasino.it (reviewed in February 2024)

An Italian online casino offering a curated selection of digital games and slots, with a focus on user experience and transparent gaming practices.

casinowizard.com (reviewed in February 2024)

Provides reviews of online slots, comparisons of slot RTPs per casino, reviews of high-payout online casinos, online casino gambling guides, and tips for the slot players.

casino.org (reviewed in March 2024)

Global gambling resource featuring online casino reviews, casino recommendations, free games and guides, as well as blog and news content covering the latest industry news and trends.

kabono.com (reviewed in March 2024)

Online casino comparison site that focuses on fairness, increased value to players and safe gambling. The website targets the UK and Norwegian markets.

allcasinos.jp (reviewed in March 2024)

Portal for safe online casino sites for Japanese players. It offers casino and game reviews, strategies, and industry updates.

simonsblogpark.com (reviewed in March 2024)

Website dedicated to creating in-depth guides to the legal status of the most common forms of online gambling, gambling taxation, and licensing worldwide. I contains 100+ casino guides, where the most known casinos in every country are reviewed in detail.

casinoromania.net (reviewed in March 2024)

Casino comparison for Romanian players, including local and international casinos, as well as database of free slots.

mybookmakers.nl (reviewed in March 2024)

Dutch sports betting website that compares legal bookmakers and their features and bonuses, so that punters can make informed decisions.

References:

Bărboianu, C. (2013). Mathematician's call for interdisciplinary research effort. *International Gambling Studies*, 13(3), 430-433.

Bărboianu, C. (2014). Is the secrecy of the parametric configuration of slot machines rationally justified? The exposure of the mathematical facts of games of chance as an ethical obligation. *Journal of Gambling Issues*, Vol. 29, 1-23.

Bărboianu, C. (2015). Mathematical models of games of chance: Epistemological taxonomy and potential in problem-gambling research. *UNLV Gaming Research & Review Journal*, 19(1), 2.

Bărboianu, C. (2019). The epistemology of the near miss and its potential contribution in the prevention and treatment of problem-gambling. *Journal of Gambling Studies*, 35(3), 1063-1078.

Bărboianu, C. (2022). *Understanding Your Game: A Mathematician's Advice for Rational and Safe Gambling*. PhilScience Press.

Bărboianu, C. (2022). Qualitative analysis of the reflection of the mathematical dimension of gambling in gaming online content – project. *Philscience*. Retrieved from <https://www.philscience.org/pages/gammathqa.html> .

Beresford, K., & Blaszczynski, A. (2020). Return-to-player percentage in gaming machines: Impact of informative materials on player understanding. *Journal of Gambling Studies*, 36(1), 51-67.

Collins, D., Green, S., d'Ardenne, J., & Wardle, H. (2014). Understanding of Return to Player messages. In conference *Harm Minimisation: Investigating Gaming Machines in Licensed Betting Offices*, London (Vol. 10).

Griffiths, M. (1993). Fruit machine gambling: The importance of structural characteristics. *Journal of Gambling Studies*, 9(2), 101-120.

Harrigan, K. A. (2007). Slot machine structural characteristics: Distorted player views of payback percentages. *Journal of Gambling Issues*, Vol. 20, 215-234.

Harrigan, K. A. (2009). Slot machines: Pursuing responsible gaming practices for virtual reels and near misses. *International Journal of Mental Health and Addiction*, 7(1), 68-83.

Lambros, C. & Delfabbro, P. (2007). Numerical reasoning ability and irrational beliefs in problem gambling. *International Gambling Studies*, 7(2), 157-171.

Leonard, C. A., & Williams, R. J. (2016). The relationship between gambling fallacies and problem gambling. *Psychology of Addictive Behaviors*, 30(6), 694.

Probability Theory Guide and Applications. <https://www.probability.infarom.ro>.

Turner, N. E., & Horbay, R. (2004). How do slot machines and other electronic gambling machines really work? *Journal of Gambling Issues*, Vol. 11.