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MATHEMATICAL MODELING OF THE PROBABILITY OF PRODUCT PURCHASE BASED ON NARRATIVE SEMANTICS THEORY

In modern marketing, a consumer's purchase decision is rarely random. It is shaped by a complex set of factors, among which the strength of the brand narrative, the level of trust, and the perceived value of the product occupy a central place. To formally describe this process, several key variables can be introduced and their interrelationship considered within an integrated model [1]. First, let N denote the intensity or effectiveness of the marketing narrative. This refers not only to the frequency of advertising messages, but also to their emotional impact, relevance to the target audience, ability to evoke associations, and capacity to remain memorable. The second factor is T - the level of trust in the brand or source of information. This indicator ranges from 0 to 1, where 0 represents complete distrust and 1 represents maximum confidence in the company's honesty and reliability. The third variable is E, the perceived value of the product. It is also measured on a scale from 0 to 1 and reflects the extent to which the product or service meets customer expectations, solves a problem, or satisfies a need. The final outcome of the interaction among these three parameters is P - the probability of purchase. This value also lies between 0 and 1. It is logical to assume that P increases as the intensity of the narrative, the level of trust, and the perceived value grow.

However, this relationship is not linear: each additional marketing effort or argument has a diminishing effect when the consumer is already close to making a purchase decision. For this reason, it is appropriate to describe the relationship using a sigmoidal (logistic) function. Such a function reflects a gradual transition from low probability to high probability, forming an S-shaped curve. At the initial stage, when N, T, and E are low, the probability of purchase remains close to zero, as the consumer does not feel sufficient motivation to act. In the intermediate range, even a small increase in narrative intensity or trust can significantly enhance purchase readiness - this is the point of greatest system sensitivity. Finally, at high values of all parameters, the curve gradually saturates, and P approaches one but never fully reaches it [2]. In formalized form, this relationship can be expressed as a logistic function of a linear combination of N, T, and E with specific weighting coefficients. These coefficients reflect the relative influence of each factor: in some markets trust may be decisive, while in others emotional richness of the narrative or perceived economic advantage may play a greater role. An additional threshold parameter accounts for a baseline propensity to purchase even under minimal marketing influence. Thus, the proposed model integrates psychological aspects of perception with mathematical formalization. It demonstrates that marketing is not only a matter of creativity but also a system of interrelated variables that can be analyzed,

measured, and predicted [1]. Within this framework, it becomes clear that an effective strategy must simultaneously strengthen the narrative, reinforce trust, and enhance perceived value, since only their synergy leads to a high probability of purchase.

Within the formalization of such dependence, it is appropriate to conceptualize the narrative as a multidimensional semantic vector whose components reflect the intensity of key meaning-related attributes: emotional saturation, identification relevance, the level of conflict and its resolution, and value congruence with the audience [2]. Let this vector be denoted as $S = (s_1, s_2, \ldots, s_n)$, where each component represents a quantitative assessment of the corresponding semantic characteristic. The probability of purchasing a product, P, can then be described as a function of this semantic space as well as individual consumer parameters C, which reflect socio-demographic and psychographic characteristics.

From a mathematical perspective, the logistic function is a natural choice, as it allows the result to be interpreted as a probability between zero and one. In its simplest form, the model can be expressed as $P = 1 / (1 + e^{(-(\beta_0 + \beta_1 s_1 + \beta_2 s_2 + \ldots + \beta_n s_n))})$. The coefficients β_i represent the weight of the corresponding semantic parameters in shaping the purchase decision. They can be estimated empirically using survey data, behavioral analytics, or experimental marketing research. A fundamental feature of this model is that it accounts not only for the intensity of individual characteristics but also for their interaction. Within narrative semantics theory, meaning emerges not in isolation but through structural relationships among elements of the story [2]. Therefore, the model can be extended by introducing interaction terms $\beta_{ij} s_i s_j$, which reflect the synergy between, for example, emotional tension and the level of identification with a protagonist. This approach makes it possible to move from a linear description to a nonlinear dynamic model of the influence of meaning structures.

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