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Assessment of Marital Satisfaction Using Support Vector Machine (SVM)

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ABSTRACT

The present study aimed to evaluate marital satisfaction using the Support Vector Machine (SVM) approach, a machine learning method known for its high classification accuracy. A cluster-randomized sample of 200 students from the Islamic Azad University, Science and Research Branch, Tehran, was selected to participate in the study. Marital satisfaction was assessed using the Enrich Marital Satisfaction Scale, a widely recognized instrument for evaluating relationship quality. Based on the results, participants reporting severe and low levels of satisfaction were classified into the "marital dissatisfaction" group, while those reporting moderate, high, and very high satisfaction were classified into the "marital satisfaction" group. Due to the relatively limited sample size, the SVM model was trained to perform binary classification and subsequently applied to predict outcomes for unobserved cases. Comparison of the model's predictions with actual outcomes demonstrated a high level of accuracy, indicating the robustness and efficiency of the SVM approach in this context. The findings underscore the value of machine learning methods in psychological and social research, particularly in predicting complex constructs such as marital satisfaction. Furthermore, the application of SVM provides psychologists with a practical, cost-effective, and time-efficient tool for early identification of individuals at risk of marital dissatisfaction. This predictive capacity can contribute to the design of targeted counseling strategies, preventive measures, and evidence-based interventions that aim to strengthen family foundations and promote marital well-being.

1. INTRODUCTION

Among the factors influencing human mental health, the family plays a pivotal role. Many psychological and behavioral abnormalities originate within the family, while numerous human achievements also stem from it. Marriage forms the core of the family unit. Today, family and couple therapy are among the most common

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therapeutic approaches in counseling and psychotherapy. Compared to findings from past decades, a substantial body of research in recent years has focused on various aspects of marital satisfaction [1].

Marital satisfaction refers to a state in which spouses experience happiness and contentment in their marriage [2]. According to [3], marital satisfaction is a subjective experience that can only be evaluated individually, based on each person's degree of contentment within the marital relationship. It is one of the most important indicators of overall life satisfaction, influencing mental health, income, academic achievement, and job satisfaction. Conversely, dissatisfaction in marital relationships can lead to social dysfunction, deviant behaviors, and erosion of cultural values between spouses [4].

Emotional and social support obtained through marriage impacts couples' physical, spiritual, and social well-being [5]. Married individuals with higher compatibility tend to live longer, engage less in risky behaviors, and experience fewer psychological issues compared to those with lower compatibility [6].

However, the role of the family has been undergoing significant changes in many countries, creating conditions for marital dissatisfaction and conflict. Recent reports by sociologists and psychologists indicate that feelings of security, tranquility, and intimate relationships between men and women have weakened, exposing families to increasingly disruptive forces and escalating marital conflicts [7].

In our country, the family holds a particularly central position, serving as the foundational social unit and the core component of society. Achieving a healthy society is contingent upon family well-being, which, in turn, depends on the mental health of its members, their ability to maintain positive relationships, and marital satisfaction [7].

In this study, marital satisfaction is first assessed using the Enrich Marital Satisfaction Questionnaire. Subsequently, a Support Vector Machine (SVM) model is trained on a subset of the data. Finally, the model predicts unobserved cases, which are compared with actual results to evaluate the accuracy of the approach.

Section 2 outlines the sampling procedure and questionnaire implementation. Section 3 introduces the SVM as a machine learning system. Section 4 presents case predictions using software simulations and compares the SVM outputs with actual data. Finally, Section 5 provides the study's conclusions.

2. LITERATURE REVIEW

Assessing marital satisfaction is a key topic in family psychology, with significant implications for individual mental health and social stability. Marital satisfaction has traditionally been measured using standardized instruments, such as the Dyadic Adjustment Scale [8] and the Multidimensional Marital Satisfaction Inventory [9]. These scales focus on various dimensions, including communication, commitment, and compatibility, and have been considered valid tools since the 1970s. However, traditional assessment methods, often based on self-report questionnaires, may be influenced by individual biases [10].

Recent advances in technology and machine learning have enabled more precise and predictive evaluations of marital satisfaction. Support Vector Machines (SVM), a powerful machine learning algorithm, have been used to predict marital outcomes based on features such as speech characteristics, demonstrating high accuracy in identifying improvements or deterioration in relationships [11]. This approach highlights SVM's potential to forecast relational dynamics through behavioral data analysis.

In studies predicting divorce as an indicator of marital dissatisfaction, SVM combined with artificial neural networks (ANN) has been applied to classify couples based on behavioral features, outperforming traditional methods [12]. Other research indicates that SVM and related machine learning techniques, including random forests, can identify key factors such as communication and conflict in divorce prediction models [13]. Additionally, in predicting postpartum depression, where marital satisfaction is an influential factor, SVM-based models using relevant features like income level and psychological resilience have achieved high predictive accuracy (up to 78%) [14]. These findings suggest that marital satisfaction can serve as a valuable input feature in SVM models for evaluating relationship health.

Hybrid approaches, such as combining SVM with particle swarm optimization (PSO) and k-nearest neighbors (KNN), have demonstrated superior performance in divorce prediction compared to SVM alone and can be extended

to assess marital satisfaction [15]. Furthermore, textual analysis of couples' language focusing on marital satisfaction has shown a correlation between positive language use and satisfaction level, which can be integrated with SVM for automated classification [16]. Meta-analytic reviews of marital satisfaction development across the lifespan also indicate that machine learning models, including SVM, can be useful for predicting long-term changes in marital satisfaction [17].

3. SAMPLING AND QUESTIONNAIRE ADMINISTRATION

Marital satisfaction is defined as an overall sense of contentment and happiness that spouses experience regarding their marriage and each other. It can also be considered the outcome of satisfaction with shared life, sexual relations, and emotional and affective fulfillment [18].

From an operational perspective, marital satisfaction is represented by the score that couples obtain on the Enrich Marital Satisfaction Questionnaire. This questionnaire comprises 47 items across 9 subscales. Scores below 30 indicate severe dissatisfaction, scores between 30 and 40 indicate dissatisfaction, scores from 40 to 60 indicate moderate satisfaction, scores from 60 to 70 indicate high satisfaction, and scores above 70 indicate exceptional satisfaction.

3.1. Population

The study population consisted of married students enrolled at the Islamic Azad University, Science and Research Branch, Tehran, in 2022.

3.2. Sampling Method

Cluster-randomized sampling was employed in this study. First, a list of faculties at the Science and Research Branch of Tehran was prepared. Four faculties Electrical and Computer Engineering, Basic Sciences, Engineering and Technology, and Humanities and Social Sciences were randomly selected from this list. From each faculty, 50 married students were randomly chosen and completed the questionnaires.

3.3. Measurement Instrument

The original version of the Enrich Marital Satisfaction Questionnaire contains 115 items covering dimensions such as personality, communication, conflict resolution, financial matters, leisure activities, sexual relations, child-rearing, extended family and friends, marital roles, and religious/spiritual orientation. Due to the length of the full version, several shorter forms have been developed. Form 15 was introduced initially [19], followed by a 47-item version [20].

The 47-item form has demonstrated high reliability, with Cronbach's alpha reported at 0.92 [19, 20]. In Iran, internal consistency was first calculated as 0.93 for the long form and 0.95 for the 47-item form [4]. In one study [21], using Pearson correlation and test-retest methods, reliability coefficients were obtained as 0.937 for men, 0.944 for women, and 0.94 for the combined sample.

For the subscales personality, communication, conflict resolution, financial management, leisure activities, sexual relationship, child-rearing, family and friends, and religious orientation the reliability coefficients were 0.76, 0.76, 0.76, 0.81, 0.63, 0.69, 0.87, 0.69, and 0.73, respectively. In Mir-Kheshti's study [4], Cronbach's alpha for the 47-item questionnaire was 0.92.

Furthermore, the questionnaire demonstrated correlations with family satisfaction scales ranging from 0.41 to 0.60, and with general life satisfaction scales from 0.32 to 0.41 [4]. All subscales effectively distinguish between compatible and incompatible couples, indicating strong criterion-related validity [22].

3.4. Scoring Method

To calculate the overall marital satisfaction score, individual responses to all 47 items are summed according to the Likert scale. Certain items (4, 6, 8, 11–16, 18–24, 30–32, 35, 37–43, and 45–47) are reverse-scored. The total raw score represents the overall marital satisfaction.

To convert the raw score into a standardized score and interpret the level of marital satisfaction, the corresponding T-score can be obtained from Table 1.

Table 1. Marital Satisfaction Questionnaire Scoring Norms

T-Score	Raw Score	T-Score	Raw Score	T-Score	Raw Score
53	183–187	33	128–132	12	73–77
55	188–192	35	133–137	14	78–82
57	193–197	36	138–142	16	83–87
59	198–202	38	143–147	18	88–92
61	203–207	40	148–152	19	93–97
63	208–212	42	153–157	21	98–102
65	213–217	44	158–162	23	103–107
67	218–222	46	163–167	25	108–112
69	223–227	48	168–172	27	113–117
71	228–232	50	173–177	29	118–122
72	233–237	52	178–182	31	123–127

Marital satisfaction levels are then interpreted as follows:

- Scores below 30 indicate severe dissatisfaction in the marital relationship.
- Scores between 30 and 40 indicate dissatisfaction.
- Scores between 40 and 60 indicate moderate satisfaction.
- Scores between 60 and 70 indicate high satisfaction.
- Scores above 70 indicate exceptional satisfaction.

In this study, scores below 40 were classified as representing dissatisfaction, while scores above 40 were considered indicative of marital satisfaction.

4. SUPPORT VECTOR MACHINE (SVM)

One of the most powerful human abilities is the capacity to learn. When a person is introduced to a problem in a new domain, their ability to solve it is minimal compared to an expert in that field. Over time, however, a novice gradually becomes familiar with the problem environment through trial and error and reasoning, thereby improving their problem-solving skills.

An analogous approach in computational systems is to design a general algorithm, supplemented with a learning mechanism. This allows the program to adapt its behavior according to each problem it encounters. Achieving this requires extracting knowledge from the domain and modifying parts of the algorithm based on this knowledge.

Support Vector Machines (SVM) are among the newer methods for solving classification problems. Due to their simple conceptual basis and high performance, they have gained considerable attention. SVM was first introduced by Vladimir Vapnik in the late 1970s and early 1980s and is grounded in the principle of structural risk minimization (SRM). Since then, SVM has been widely applied in various studies [23–24].

Unlike empirical risk minimization, which is used in neural networks to minimize training data errors, SRM aims to reduce the upper bound of the error for unseen test data. Consequently, SVMs generally offer better generalization performance than conventional neural networks.

The Vapnik-Chervonenkis (VC) dimension is a property of a set of functions {f(α)}. Since in most cases, each input data point is classified into one of two classes, each input xxx can be assigned a label of +1 or −1 depending on its class. For an input set of L instances, the SVM can label L^2 possible states (in the binary classification case). If there exists a function in {f(α)} that correctly classifies all training instances, we say that the set of points has been "shattered" by the function set. The VC dimension is defined as the maximum number of training points that can be shattered by {f(α)}.

One of the most common methods for visualizing point separation in an n-dimensional space is to represent a hyperplane in Rn. Points located on one side of the hyperplane are assigned the label +1, while points on the other side are labeled −1.

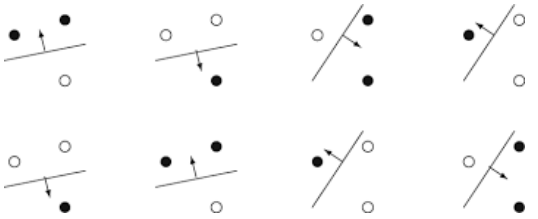

Fig. 1. Separation of Points Using a Hyperplane [25]

The Vapnik-Chervonenkis (VC) dimension provides a good estimate of the capacity of a function set to fit a given dataset. However, in some cases, it is not possible to achieve separation with a single hyperplane. That is, a minimum of h points can be shattered, but not necessarily every subset of hhh points. The following example illustrates this concept:

Fig. 2. Separation of Points Using Multiple Hyperplanes [26]

As observed, the three points shown cannot be shattered by the selected set, i.e., the oriented lines.

Vapnik and colleagues proposed an algorithm for constructing separating hyperplanes from empirical data. This algorithm was designed for linearly separable problems and is based on the principle that among all possible separating hyperplanes, there exists a unique hyperplane that maximizes the margin between classes. (Increasing the margin reduces the model's capacity.)

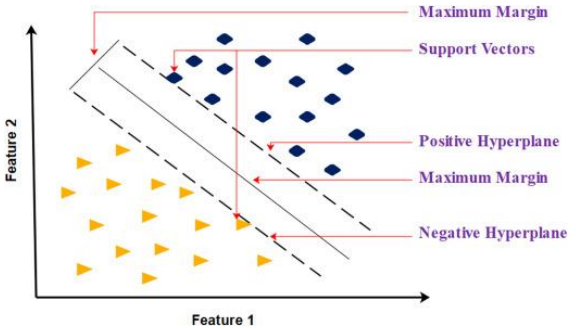

Fig. 3. Optimal Hyperplane for the Linearly Separable Case [27]

5. SIMULATION

For this study, the results of the Enrich Marital Satisfaction Questionnaire were utilized. In the first step, the system calculated the T-score of the questionnaire responses using MATLAB. Subsequently, participants were classified into two groups: satisfied and dissatisfied with their marital relationships.

Based on this classification, a Support Vector Machine (SVM) was trained using the Lib SVM software with the individual questionnaire data as the training set. Using the trained model, predictions were made for the remaining cases (i.e., the couples' questionnaires). Finally, the predicted results from the simulation were compared with the actual outcomes to evaluate the accuracy of the model. The results are presented in Table 2.

Table 2. Comparison of SVM Prediction Results Based on Training Data for the Enrich Marital Satisfaction Questionnaire

SVM Core				Actual Marital Satisfaction	Questionnaire Number
RBF	Precomputed	Linear	Polynomial		
1	1	1	-1	1	**2**
1	1	1	-1	1	**4**
-1	-1	-1	-1	-1	**6**
-1	-1	-1	-1	-1	**8**
-1	-1	-1	-1	-1	**10**
-1	-1	-1	1	-1	**12**
-1	-1	-1	-1	-1	**14**
1	1	1	-1	1	**16**
-1	-1	-1	-1	-1	**18**
-1	-1	-1	-1	-1	**20**
-1	-1	-1	-1	-1	**22**
-1	-1	-1	1	-1	**24**
-1	-1	-1	-1	-1	**26**
1	1	1	-1	1	**28**
-1	-1	-1	-1	-1	**30**
-1	-1	-1	-1	-1	**32**
-1	-1	-1	-1	-1	**34**
-1	-1	-1	1	-1	**36**
-1	-1	-1	-1	-1	**38**
-1	-1	-1	1	-1	**40**
-1	-1	-1	-1	-1	**42**
-1	-1	-1	-1	-1	**44**
1	1	1	1	1	**46**
-1	-1	-1	-1	-1	**48**
1	1	1	1	1	**50**
-1	-1	-1	1	-1	**52**
1	1	1	-1	1	**54**
-1	-1	-1	-1	-1	**56**
-1	-1	-1	1	-1	**58**
-1	-1	-1	-1	-1	**60**
1	1	1	-1	1	**62**
-1	-1	-1	1	-1	**64**
1	1	1	-1	1	**66**
-1	-1	-1	1	-1	**68**
-1	-1	-1	-1	-1	**70**
-1	-1	-1	-1	-1	**72**
1	1	1	1	1	**74**
-1	-1	-1	-1	-1	**76**
1	1	1	-1	1	**78**
1	1	1	1	1	**80**
-1	-1	-1	-1	-1	**82**

-1	-1	-1	-1	-1	**84**
1	1	1	1	1	**86**
-1	-1	-1	1	-1	**88**
-1	-1	-1	1	-1	**90**
-1	-1	-1	1	-1	**92**
-1	-1	-1	1	-1	**94**
-1	-1	-1	-1	-1	**96**
-1	-1	-1	1	-1	**98**
-1	-1	-1	-1	-1	**100**
100	100	100	95		**SVM Prediction Accuracy**

For the simulation, the results of the Enrich Marital Satisfaction Questionnaire were utilized. In the first step, the system calculated the T-score for each respondent using MATLAB software. Subsequently, participants were classified into two categories: satisfied and dissatisfied with their marital relationships. Based on this classification, the Support Vector Machine (SVM) was trained using the LibSVM toolbox on a subset of respondents (training questionnaires), and predictions were then made for the remaining participants. Finally, the predicted results from the SVM were compared with the actual responses to assess the model's accuracy. The results are presented in Table 2.

As observed in Table 2, the SVM successfully estimated marital satisfaction with high accuracy. This approach accelerates the assessment process, allowing psychologists to quickly and reliably determine clients' marital satisfaction and implement appropriate interventions. Based on the limited training data, the SVM demonstrated strong predictive ability, suggesting that this method can efficiently classify participants in larger populations and similar questionnaires in a short time with high precision.

6. CONCLUSION

In general, evaluating all marital satisfaction questionnaires to determine whether participants are satisfied or dissatisfied is a time-consuming and costly task. Utilizing software-based analysis significantly reduces both time and cost, providing psychologists with immediate access to results. This enables them to design strategies for improving marital relationships and strengthening family foundations.

In this study, SVM was employed to simulate the classification of participants into satisfied and dissatisfied groups. The results indicate that, even with limited training data, the SVM accurately predicted the satisfaction levels of other participants across different kernels. Therefore, this method provides a rapid and precise tool for psychologists, allowing for efficient evaluation of marital satisfaction and guidance in developing improvement strategies, while saving both time and resources.

Transparency Statement

The data supporting this study are available upon reasonable request to the corresponding author, subject to ethical and confidentiality considerations.

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Declaration of Interest

The authors declare that they have no competing interests.

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