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Research on the History of Ancient Multi-ethnic Interaction and Cultural Integration Path through Association Rule Mining Algorithm under the Perspective of National Unity Education

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Abstract This study explores the history of multi-ethnic interaction and the path of cultural integration from the perspective of national unity education, combining association rule mining and questionnaire survey. Based on Apriori algorithm for association term analysis, text classification is carried out using plain Bayesian network. Based on the improved Apriori text mining model, combined with the field questionnaire survey data and the historical ethnic interaction event database, the strong correlation rules such as "traditional festival participation → cross-ethnic dinner" (confidence 83.1%) and "keeping promises → employment mutual assistance" (78.3%) were excavated, and it was found that the average confidence of food culture rules (0.79) was significantly higher than that of religious ritual rules (0.64), revealing the important role of material and cultural exchange in ethnic integration. Based on the comparative experimental results, the detection accuracy of the improved Apriori algorithm is verified. The data of 790 questionnaires show that the awareness of "religious belief" and "customs" of various ethnic groups constitutes the most significant difference dimension, and the average awareness of the difference in "customs and habits" reaches 60.3%. Ethnic interaction attitudes show a high degree of consistency, with more than 95% of the respondents taking honesty and reliability as the main preferred criteria for choosing friends. Accordingly, this paper proposes a third-order ethnic interaction history and cultural integration path, which provides a methodological support with both spatio-temporal precision and cultural depth for multi-ethnic interaction in the new era.

Index Terms plain Bayesian network, Apriori algorithm, ethnic interaction, cultural integration, association rules

I. Introduction

China is a unified multi-ethnic country with the Han nationality as the main body, and the history of the motherland is written by people of all nationalities [1]. The various ethnic groups have exchanged and absorbed each other, depended on each other and integrated, and together they have created a unified multi-ethnic country. Ethnic integration is the main vein running through the process of China's historical development, indicating the inevitable trend of the development of a unified multi-ethnic state [2]. Ethnic integration is an important content in the process of Chinese historical development, and ethnic integration shows its prominent historical status and role for the initiation and development of Chinese civilization [3]. The so-called ethnic integration refers to the equal coexistence, economic and cultural exchanges, mutual influence of living habits, and gradual convergence of production methods among various ethnic groups [4], [5]. The study of this issue has always been an important topic in the study of ethnic history, but also in recent years, the development of ethnic history research is rapid.

Culture can be a force of integration as well as division [6]. When different cultures meet and collide and identify with each other, absorb each other and integrate with each other, culture is the power of integration [7]. Cultural integration produces a common cultural foundation, which in turn produces a more consistent national psychology, enhances national cohesion, and strengthens the centripetal force of the country [8], [9]. When different cultures meet and collide and oppose, exclude and conflict with each other, culture becomes a divisive force [10]. Cultural conflict leads to ethnic segregation, and profound cultural conflict leads to ethnic division and national division. Therefore, under the perspective of national unity education, mining the history of multi-ethnic interactions and the path of cultural integration through emerging technologies is an important prerequisite for Chinese ethnic groups to be able to live in harmony, make peace and develop harmoniously [11].

This paper firstly summarizes the law of multi-ethnic interaction and cultural integration from the perspective of historical development. The feature association analysis of the text obtains the associated features, applies the Bayesian network text classifier for classification, and designs the improved Apriori algorithm for text data mining. Based on the field questionnaire survey, the current situation of the interaction of various ethnic groups in A town is

analyzed. The improved Apriori algorithm is used to mine the cultural association features and reveal the significant cultural association patterns of each ethnic group. Based on the data of the willingness of various ethnic groups to interact, double corroborate the credibility of the cultural intermingling pattern. Combining the data mining and questionnaire survey results, the history of ethnic interaction and the path of cultural integration are proposed.

II. Recognition of the regularity of historical multi-ethnic interaction and cultural integration

China is a country with a long history and a splendid culture, and the formation and development of the Chinese nation is broadly characterized by the following stages:

First, from the pre-Qin to Qin-Han periods, the Chinese nation went from being nascent to being initially formed and began the historical process of diversification and integration. The Chinese Civilization Exploration Project has proved that China's civilization of more than 5,000 years had the typical characteristics of accepting all rivers and radiating in all directions in the early period.

Secondly, during the Wei, Jin, and North and South Dynasties, the Chinese nation experienced an unprecedented migration and intermingling. During this period, the great migration of nationalities was characterized by many causes of migration, many nationalities, a large scale of migration, a wide range of migration areas, and many directions of migration, and the scale and degree of national integration reached a new height.

Thirdly, the Sui and Tang dynasties were a glorious period of reconstruction of China's “great unification” after the Qin and Han dynasties, and an important stage in the unprecedented development of the Chinese nation. Along with the economic and cultural prosperity, trade activities and cultural ties between China and foreign countries were very active, and the exchanges and interactions among various ethnic groups were further deepened, resulting in the further development of the Chinese national community.

Fourth, during the period from the Five Dynasties and Ten Kingdoms to the Yuan, Ming and Qing Dynasties, the Chinese nation was reunited by partition. During this period, the national boundaries and the pattern of ethnic distribution tended to stabilize, and the pattern of the unity of the Chinese nation was finalized. In particular, the migration and integration of ethnic groups during the Ming and Qing periods were no less important than those of other periods, both in scale and in degree, and the culmination of the cultural integration of the various ethnic groups once again occurred within the Chinese cultural system.

Fifthly, in the modern period after the outbreak of the Opium War, the Chinese nation turned from self-consciousness to self-awareness and finally gained independence and liberation. After the outbreak of the Opium War, the Chinese nation gradually transformed itself from an ancient pluralistic and self-contained aggregation to a modern one-person and self-conscious community. After the founding of the Communist Party of China (CPC), it combined the basic principles of Marxism with China's concrete realities and with its outstanding conflicting cultures, and led the people of all nationalities to the final victory against imperialism and feudalism, ushering in a new era of development for the Chinese nation.

Sixth, after the founding of the People's Republic of China, the Chinese nation put a complete end to the oppression and suffering it had suffered since the Opium War, and truly realized the transition from a dynastic to a modern state. Under the leadership of the Communist Party of China (CPC), the Chinese people of all ethnic groups have been working tirelessly for the great rejuvenation of the Chinese nation, and are moving towards the goal of building a modern socialist power.

To summarize, the Chinese nation is an ethnic community with rich connotations based on long-term exchanges and intermingling and closely knit together.

III. Design of Apriori Text Mining Models Combined with Simple Bayesian Networks

Historical text data are characterized by semantic complexity, structural heterogeneity, and temporal order, etc. The traditional Apriori algorithm faces bottlenecks such as inefficient generation of frequent itemsets and insufficient capture of cultural-semantic associations when dealing with such data. For this reason, this study utilizes the associated feature terms combined with the original feature terms to represent the feature terms for text classification, and applies them as attribute variables to the plain Bayesian network text classifier.

III. A. Principles of association rules

III. A. 1) Concepts

Let I be the set of all items, $I=(I_1,I_2,\cdots,I_n)$, and the set of things $D=(D_1,D_2,\cdots,D_n)$, and the set of affairs contain item set I consists of one or more items, so let $D_n=(I_1,I_2,\cdots,I_n)$. An item set is said to be a frequent

item set or a frequent K item set if K item sets exist in the transaction set and the support of the item set found by searching the database is greater than the support threshold (minimum support).

An association rule is said to be a strong association rule when it indicates that a frequent itemset introduces another frequent itemset with support and confidence greater than the minimum support and minimum confidence, respectively. An association rule is an expression of the form $A \Rightarrow B$, where A and B are non-empty subsets of all the itemsets in the dataset, which serve as the antecedent and consequent terms of the association rule, respectively, and $A \cap B = \varnothing$. Support, confidence and lift are the three core metrics for measuring association rules.

(1) Confidence

Confidence denotes the probability that a subsequent term B occurs if the previous term A is true. That is, the probability that item A and item B occur simultaneously under the condition that item A occurs. It has a value between 0 and 1. The closer to 1, the higher the correlation between the events. That is, it means that the conditions under which A item occurs are more likely to lead to the occurrence of B item. The expression for confidence level calculation is:

$$Confidence(A \Rightarrow B) = P(B \mid A) = \frac{P(A \cap B)}{P(A)} \tag{1}$$

(2) Support

The degree of support represents the probability that the antecedent A and the consequent B occur simultaneously. It is shown in the following equation and the degrees of support in this equation are symmetrical to each other. That is, $A \Rightarrow B$ can also be expressed as $B \Rightarrow A$, the support of A to B in the rule is equivalent to the support of B to A. The support value is useful for measuring the correlation between item sets and determining whether it is valuable for research. If the support degree is lower than a certain value, it means that the association rule is invalid. The expression for calculating support is:

$$Support(A \cap B) = P(A \cap B) \tag{2}$$

(3) Elevation degree

The degree of enhancement indicates the ratio of the confidence level of the former item A and the latter item B to the enhancement level of the latter item B, which is the probability of the simultaneous occurrence of A and B items divided by the probability of the occurrence of A and B items respectively under the condition that A and B items are independent, which indicates the validity and importance of the association rule. The higher the degree of elevation, the greater the influence of A-item on B-item, the degree of elevation of a strong association rule should be more than 1, i.e., A-item and B-item are positively correlated, if the degree of elevation is less than or equal to 1, A-item and B-item are not correlated or mutually exclusive. The lifting degree calculation expression is:

$$Lift(A \cap B) = \frac{confidence(c)}{P(B)} = \frac{P(B \mid A)}{P(B)} = \frac{P(A \cap B)}{P(A)P(B)} \tag{3}$$

As above, the three metrics in the association rule that describe the degree of validity of the association rule are confidence, support, and lift. Confidence indicates the degree of correlation between the events of the antecedent A and the consequent B, and support is mainly used to describe the probability of occurrence between the antecedent A and the consequent B. The degree of enhancement indicates the degree of correlation between the preceding item A and the following item B.

III. A. 2) Algorithmic steps

Association rule mining is first divided into two steps. Firstly, iterating through all the frequent itemsets in the database to form a frequent itemset, and then joining that frequent itemset, then the candidate itemsets in the database are generated. Secondly, the support of the generated candidate itemset is compared with the minimum support and the smallest frequent itemset is output.

The algorithm flow is shown in Fig. 1, which can be elaborated as:

(1) Iterate through all the frequent itemsets in the database to form the frequent itemset L1 (first-order frequent itemset);

(2) Generate candidate item set C2 based on the connection between frequent item sets L1, and perform pruning verification on candidate item set C2;

(3) Calculate the support degree of the candidate item set in the database, determine whether the support degree of the candidate item set C2 is greater than the minimum support degree, and delete the candidate item set C2 if it

is less than the minimum support degree, and obtain the frequent item set L2 if it is greater than the minimum support degree;

(4) Cyclically run steps 1-step 3 repeatedly until the candidate set cannot be generated;

(5) Generate all frequent itemsets Lk;

(6) Calculate all the itemset confidence, determine whether the frequent itemset confidence is greater than the minimum confidence, if greater, then output the association rule.

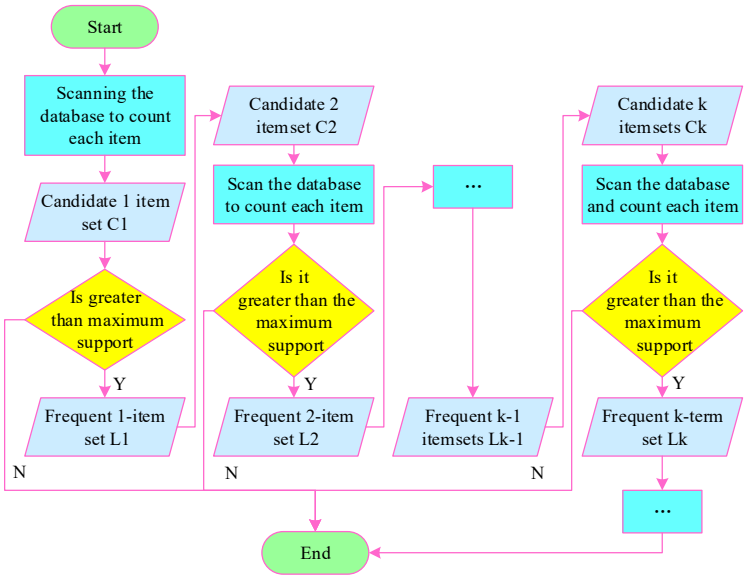

Figure 1: Apriori algorithm mining step

III. B. Mining Associative Feature Items in Text

In the historical text feature item association rule mining, if we follow the Apriori algorithm introduced above to directly mine the associated feature items in the text, then an associated feature item such as {data, algorithm}, two words data and algorithm as long as the same time in a piece of text, no matter how many times each word appeared, the support of the associated feature item In the calculation formula, the numerator value is only increased by 1, which ignores the effect of the number of times the feature term appears on the text category. In addition, the number of samples contained in each category in the training text set may vary greatly, if the number of texts in the whole training sample set is used to calculate the support, and a uniform minimum support is used to mine the associated feature items, then some frequent sets appearing on the categories with a small number of samples are filtered out because they do not satisfy this minimum support, e.g., there is a sample set with 500 texts divided into two categories, one category of 100 articles, the other 400 articles, the feature term {data, algorithm} occurs in each of the 100 texts of the first category, and does not occur in any of the 400 texts of the latter category, then according to the Apriori algorithm, the support of the feature term {data, algorithm} in the whole dataset is 20%, and if the support of 30% is used as the threshold, then the feature term {data, algorithm} will be filtered out. 30% support as a threshold, this feature value will be missed, but this feature term contains a large amount of category information, which is useful for distinguishing two categories.

In order to solve the above problem, one of the solutions is to divide the whole training text set into groups according to the categories, and then mine the frequent feature items set in each group, and then finally combine the set of associated features in each group to constitute the set of associated feature items of the whole training text. Another method is to improve the support algorithm to mine the associated feature items in the text, here first introduce the concept of document-word matrix, each data in the document-word matrix represents the frequency of a word in a given text, the word frequency of each word in a text divided by the word frequency of the word in all the text and the sum of the word frequency of the word to get a normalized document-word matrix, the normalization not only ensures that the resulting The normalization not only ensures that the resulting support is a number between 0 and 1, but also ensures that the data is on the same scale so that sets of feature terms that vary in the same way can have similar support values. The following is a normalized document-word matrix:

$$\begin{array}{c} \\ d_1 \\ d_2 \\ \vdots \\ d_m \end{array} \begin{array}{c} \begin{array}{cccc} t_1 & t_2 & \cdots & t_n \end{array} \\ \begin{bmatrix} f_{11} & f_{12} & \cdots & f_{1n} \\ f_{21} & f_{22} & \cdots & f_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ f_{m1} & f_{m2} & \cdots & f_{mn} \end{bmatrix} \end{array} \tag{4}$$

where $\{d_1, d_2, \cdots, d_m\}$ denotes the set of texts, d_j denotes the j th text, $\{t_1, t_2, \cdots, t_n\}$ denotes the set of feature terms, t_i denotes the i th feature term, f_{ij} denotes the normalized frequency of feature term t_i in text d_j, and

$$\sum_{i=1}^{m} f_{ij} = 1 \tag{5}$$

In the new algorithm, the support of the associated feature items can be calculated based on the word frequencies inside the normalized document-word matrix, specifically by taking the minimum of the normalized frequencies of each feature item in the set of feature items. For example, the normalized frequency of t_i in text d_j is f_{ij}, and the normalized frequency of t_k in text d_j is f_{kj}, then the support of the feature item set $\{t_i, t_k\}$ in text d_j is $\min\{f_{ij}, f_{kj}\}$. In general, the support of the set of feature terms $\{t_1, t_2, \cdots, t_l\}$ over the whole dataset is obtained by summing up its support over each text:

$$\sup port(\{t_1, t_2, \cdots, t_l\}) = \sum_{i=1}^{m} \min_{d_i \in D} (f_{i1}, f_{i2}, \cdots, f_{il}) \tag{6}$$

III. C. Text Classification Based on Associative Features

An example of combining association features for text classification is presented below. Let the training text set includes two categories C_1 and C_2, and each text contains 50 texts, after text preprocessing, 20 original feature terms are obtained, and after association rule construction and feature filtering, 3 original terms (t_1, t_2, t_3) and 2 associated feature terms (t_{12}, t_{123}) are obtained, in which the subscripts of the associated feature terms indicate that the feature term consists of which original feature terms, such as t_{12} indicates that the feature term is composed of the original feature terms t_1 and t_2, with these five feature terms as the feature terms of classification, firstly, establish the network structure of the text classification model, and here we take the plain Bayesian network classifier as the text classification model of this example, and secondly, determine the parameters of the nodes of the plain Bayesian network, i.e., conditional probability table (CPT) of each node, and find the conditional probability of each node, and then determine the conditional probability of each node. Table (CPT), to find the conditional probability of each feature term as follows.

For an unknown category of text $d = \{t_1, t_2, t_3, t_{12}, t_{123}\}$, its individual feature term word frequency is 2, 5, 9, 1, 11, respectively, the plain Bayesian network classifier classifies the unknown category of text into the class that has the maximum a posteriori probability. Posterior probability of the class, according to the conditional probability table learned above, there are

$$\begin{aligned} P(d \mid C_1) &= P(t_1 \mid C_1) P(t_2 \mid C_1) P(t_3 \mid C_1) P(t_{12} \mid C_1) P(t_{123} \mid C_1) \\ &= (4/7)(4/9)(1/7)(1/2)(2/7) = 0.0052 \end{aligned} \tag{7}$$

$$\begin{aligned} P(d \mid C_2) &= P(t_1 \mid C_2) P(t_2 \mid C_2) P(t_3 \mid C_2) P(t_{12} \mid C_2) P(t_{123} \mid C_2) \\ &= (5/7)(1/3)(1/3)(2/7)(1/6) = 0.0038 \end{aligned} \tag{8}$$

Since $P(d \mid C_1) > P(d \mid C_2)$ and $P(C_1) = P(C_2) = 1/2$, the text d is divided into the category C_1.

IV. Exploration of the history of ethnic interaction and the path of cultural integration based on the analysis of association rules

IV. A. Population development and ethnic composition

As a multi-ethnic settlement area, Town A has a diverse ethnic demographic composition and a long history of ethnicity, and this paper will describe the population distribution of various ethnic groups in Town A as a whole.

Population is the master of social activities and the creator of material production in a place, and it is only with population that the place can prosper and develop. Initially, the population of A Town was composed of Tibetan, Yugu and Han Chinese. At that time, the total population of the three parts of the town was 365 households with 1,755 people. Later, 15 villages in 3 townships settled in A Township, through marriage and marriage, gradually formed the total population of A Township today, and became the driving force of economic and social development and prosperity of A Township and the production of vitality.

Table 1 shows the number of people and the percentage of ethnic groups in A Township. The data show that after 1997, the population development of A Town was in a stage of basic stabilization and slight decline, maintaining a period of development with low fertility.2024 At the end of the year, the population of the town was 2,635 households with 8,298 people; 3,532 Han Chinese, accounting for 42.56%, 2,569 Tibetans, accounting for 30.96%, and 1,688 Yugus, accounting for 20.34%.The main ones living in the territory of A Town are Yugur, Tibetans and Han Chinese are the three major ethnic groups, and the ethnic composition of the town is composed of 10 ethnic groups, including Yugur, Tibetans, Han Chinese, Hui, Turks, Mongols, Manchus, Salarians and Dongxiangs.

Table 1: Ethnic population and proportion statistics of town A from 1368 to 2024

Year		1379	1686	1840	1997	2011	2024
Total population		1755	5722	6590	8064	8155	8298
The Yugu nationality	Population	413	986	1076	1875	1629	1688
	Proportion	23.53%	17.23%	16.33%	23.25%	19.98%	20.34%
The Zang nationality	Population	525	1134	1257	2098	2478	2569
	Proportion	29.91%	19.82%	19.07%	26.02%	30.39%	30.96%
The Han nationality	Population	632	3277	3886	3662	3557	3532
	Proportion	36.01%	57.27%	58.97%	45.41%	43.62%	42.56%
The Mongolian nationality	Population	31	22	15	8	47	48
	Proportion	1.77%	0.38%	0.23%	0.10%	0.58%	0.58%
The Hui nationality	Population	128	196	215	297	268	274
	Proportion	7.29%	3.43%	3.26%	3.68%	3.29%	3.30%
The Tu nationality	Population	26	105	132	119	167	175
	Proportion	1.48%	1.84%	2.00%	1.48%	2.05%	2.11%
Other nationalities	Population	0	2	9	5	9	12
	Proportion	0%	0.03%	0.14%	0.06%	0.11%	0.14%

IV. B. Analysis of interactions among ethnic groups

The fieldwork for this paper focused on the period from March 2024 to November 2024. The survey respondents involved groups of different ethnicities, ages, occupations, and educational backgrounds, with occupations involving herders, farmers, civil servants, teachers, students, businessmen, and other social groups, and ethnicities including Yugur, Han, Tibetan, Hui, Tu, and Mongolian. A total of 925 questionnaires were distributed and 860 questionnaires were returned, of which 790 were valid, with a validity rate of 91.86%.

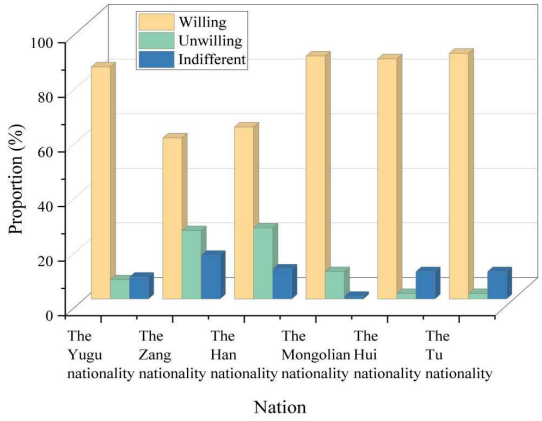

Figure 2: Respondents' willingness to live in multi-ethnic communities

The author made a questionnaire survey for the ethnic interaction in Town A. The respondents' willingness to live in a mixed multi-ethnic neighborhood is shown in Figure 2. From the subjective choice of the willingness to live in the neighborhood, nearly 70% of the respondents explicitly indicated that they were willing to live in the multi-ethnic mixed community, which can be seen that the proportion of the population that can accept the multi-ethnic mixed living among the interviewees is very high. In terms of ethnicity, Yugu, Hui, and Tu respondents were not opposed to living in a community with other ethnic groups, while the proportion of Han Chinese who were “unwilling” (26%) was slightly higher, followed by Tibetans (25%) and Mongolians (10%).

The frequency of inter-ethnic interactions in the neighborhood is shown in Figure 3, with one-fourth of the respondents indicating that they interact with other ethnic groups “very much,” indicating that inter-ethnic interactions occur frequently in the local area. The occasions of interactions are mostly focused on work interactions, economic interactions, interactions between neighbors, and interactions between friends based on these interactions. Among the different ethnic groups, the Yugu and Mongolians were not found to have no interactions with other ethnic groups, while a small number of Tibetans (2%), Han Chinese (3%), Hui (2%), and Turks (1%) indicated that they “never” had interactions with other ethnic groups.

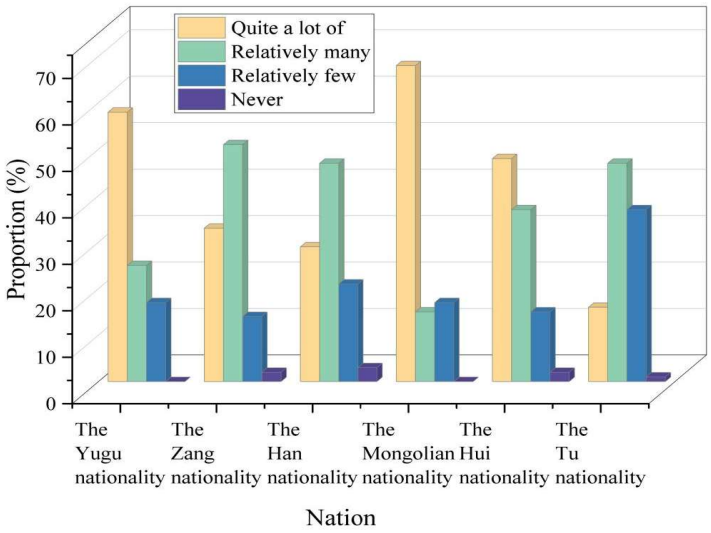

Figure 3: The frequency of neighborhood contacts of the respondents

Table 2: Results of mining cultural correlation features

Preceding paragraph	Consequent	Confidence degree/%	Support degree/%
Participation in traditional festivals	Cross ethnic gathering	83.1	31.4
Keeping promises	Civilian mutual assistance	82.4	28.7
Tea Horse Exchange	Language exchange	79.5	22.4
Honesty and trustworthiness	Employment mutual assistance	78.3	25.9
Recognition of local customs and traditions	Cross ethnic intermarriage intention	76.2	31.4
Inheritance of traditional skills	Mutual sharing of ethnic resources	75.9	24.8
Religious identity	Cross ethnic intermarriage intention	66.5	23.7
Belief conflict	Resource conflict	61.8	22.5

IV. C. Mining of culturally relevant features

Through the cross-analysis of the text coding of 790 valid questionnaires in Town A and the library of historical ethnic interaction events, which is a combination of several official histories, local records, private writings, archival documents, and stone carvings, the improved Apriori model was used to mine out the statistically significant strong association rules, and the results of the association analysis of the cultural characteristics were obtained, as shown in Table 2. In contemporary ethnic exchanges, the rule of "participation in traditional festivals and → cross-ethnic dinners" has become the most significant cultural association model with a confidence level of 0.83 (support degree of 0.31), and its strength is 4.5% higher than that of the "tea and horse market→ language exchange" rule of historical data (0.79). It is worth noting that the confidence level of the rule of "keeping promises → people-to-people mutual assistance" is 0.82 in historical data, and the confidence level of "honesty and trustworthiness →

employment mutual assistance" in the contemporary sample is still 0.78, reflecting that honesty and trustworthiness have always been an important condition for cross-ethnic exchanges from ancient times to the present. The in-depth analysis found that the average confidence level of food culture rules (0.79) was significantly higher than that of religious ritual rules (0.64), indicating that material and cultural exchanges still constitute the basic carrier of contemporary ethnic integration.

In the algorithm performance comparison experiment, the accuracy rates of the three algorithms were recorded in the test to assess the performance advantages of the improved Apriori algorithm, and the experimental results are shown in Table 3, which shows that the improved Apriori algorithm demonstrates a significant advantage in the key indicators. For the specific scenario of cultural integration path, the average accuracy rate of the improved Apriori algorithm reaches 93.2% with the ethnic interaction event as the test unit. When detecting asymmetric cultural communication events, the accuracy of the improved Apriori algorithm is as high as 96.5%, which is 11.2 percentage points higher than that of the Apriori algorithm with the next highest performance. These results indicate that the improved Apriori algorithm can effectively capture the ephemeral characteristics of ethnic cultural integration, providing a more spatio-temporally sensitive analytical tool for the study of multi-ethnic interactions.

Table 3: Text data mining accuracy of the three algorithms

Event unit	FP-Growth	Apriori	Improved Apriori
One-way penetration of language transmission	73.6%	83.1%	92.6%
Technology diffusion is a two-way interaction	75.4%	86.4%	93.8%
Border trade flow resource monopoly	78.2%	80.5%	90.7%
Covenant-making consultative governance	72.8%	87.2%	94.3%
Religious Activities→Economic activities	70.9%	86.2%	94.7%
Festivals→Religious dissemination	75.3%	84.4%	98.2%

IV. D. Analysis of the willingness of ethnic groups to interact

IV. D. 1) Awareness of ethnic interaction

Ethnic interaction consciousness is a social construction in the process of ethnic interaction, which is the result of ethnic members' cognition of the autonomy, independence, wholeness and other aspects of their own ethnicity in interaction with other ethnic groups as well as their individual ethnicity, and ethnic consciousness is a partial reproduction of the cognitive result or psychological experience under certain conditions. This cognitive result guides the cognitive activities and behaviors of members of each ethnic group. The results of the survey on the degree of differences between ethnic groups are shown in Table 4. The data in Table 4 show that the proportion of all ethnic groups that perceive the degree of ethnic difference as mild exceeds 50%, and only Tibetans (7.7%) and Hui (10.6%) perceive that there is a significant difference of more than 5%. It is worth noting that the percentage of Tibetans agreeing with the “identical” option is 32.6%, significantly higher than that of other ethnic groups, suggesting the special influence of their tradition of cultural inclusiveness on cognitive construction.

Table 4: Cognitive survey results of ethnic differences

Option	Totally different	Mildly differentiated	Perfectly consistent	Left unanswered
The Yugu nationality	1.7%	68.2%	28.5%	1.6%
The Zang nationality	7.7%	59.7%	32.6%	0%
The Han nationality	2.6%	71.3%	25.4%	0.7%
The Mongolian nationality	1.5%	74.5%	23.2%	0.8%
The Hui nationality	10.6%	59.6%	29.8%	0%
The Tu nationality	2.4%	58.8%	38.5%	0.3%

The results of the survey on the degree of awareness of ethnic differences are shown in Table 5. The cognitive differences of various ethnic groups on "communication concept" and "national costume" are relatively low, and the cognitive degree of "religious belief" and "customs and habits" constitutes the most significant difference dimension, and the average cognitive degree of each ethnic group on the difference of "customs and habits" reaches 60.3%, which is closely related to the national cultural genes.

Table 5: Survey results on the degree of cognition of ethnic difference points

Option	Religious belief	Customs and habits	Communication concept	National costume
The Yugu nationality	42.6%	51.7%	2.3%	3.4%
The Zang nationality	39.1%	58.5%	1.6%	0.8%
The Han nationality	29.5%	59.3%	5.2%	6.0%
The Mongolian nationality	22.1%	70.2%	3.3%	4.4%
The Hui nationality	34.2%	62.1%	2.9%	0.8%
The Tu nationality	33.8%	59.7%	6.1%	0.4%

IV. D. 2) Attitudes towards ethnic interaction

Interethnic interaction attitude is the inner structure of the more durable ethnic psychology it is the intermediary factor between external stimuli and the individual reflection of the ethnic group, it is the synthesis of a nation's cognition, feelings and intentions towards other nations. Interaction attitude cannot be directly observed, but it can be expressed in people's words, actions and other aspects, and it reflects the cognitive results, national emotions and psychological distance between members of the ethnic group. In the questionnaire survey, the question of “all ethnic groups have merits and should learn and help each other”, the results of the survey on the interaction attitude of each ethnic group are shown in Table 6, with an average of more than 90% of the respondents agreeing completely or basically with the concept of interaction that all ethnic groups have merits and should learn and help each other. This general agreement stems not only from the leading role of socialist core values, but also reflects the positive emotional connection formed in the practice of ethnic interaction.

Table 6: Survey results of communication attitudes of different ethnic groups

Option	Totally agreed	Largely agreed	Normal	Slightly disagree	Totally disagree
The Yugu nationality	89.6%	9.5%	0.2%	0.7%	0%
The Zang nationality	77.3%	17.5%	3.2%	1.7%	0.3%
The Han nationality	84.5%	9.8%	4.6%	1.1%	0%
The Mongolian nationality	84.7%	12.5%	1.6%	1.2%	0%
The Hui nationality	78.2%	16.7%	4.2%	0.3%	0.6%
The Tu nationality	89.5%	5.4%	4.6%	0.4%	0.1%

The results of the survey on the criteria for ethnic friendships are shown in Table 7, with more than 95% of the respondents citing honesty and trustworthiness as the main preferred criteria for choosing friends. This choice pattern reveals the behavioral logic of “quality over identity” in ethnic interactions, and these two surveys reflect the fact that ethnic groups do not have a narrow ethnic consciousness in their interactions, but maintain an attitude of tolerance, trust and learning from each other, and pay attention to the choice of good and bad in human nature.

Table 7: Results of the national dating standards

	Same nation	Honest and reliable	Other
The Yugu nationality	1.2%	93.2%	5.6%
The Zang nationality	3.6%	93.8%	2.6%
The Han nationality	1.7%	97.1%	1.2%
The Mongolian nationality	1.1%	96.5%	2.4%
The Hui nationality	2.7%	93.2%	4.1%
The Tu nationality	1.5%	96.8%	1.7%

To sum up, the differentiated perception of religious beliefs and customs of various ethnic groups reflects the historical continuity of cultural genes, while the universal recognition of national symbols and modern communication paradigms highlights the effectiveness of the construction of the Chinese cultural community. The high degree of consistency in attitudes toward ethnic interaction and the quality orientation of dating standards together constitute the practical foundation of national unity education.

V. Conclusions and strategies

V. A. Conclusion

This paper combines Apriori association rule mining and questionnaire survey results to explore multi-ethnic interaction patterns.

In contemporary ethnic exchanges, the rule of "participation in traditional festivals and → cross-ethnic dinners" has become the most significant cultural association model with a confidence level of 0.83 (support degree of 0.31), and its strength is 4.5% higher than that of the "tea and horse market→ language exchange" rule of historical data (0.79). The confidence level of the rule of "keeping promises →people-to-people mutual assistance" is 0.82 in the historical data, and the confidence level of "honesty and trustworthiness → employment mutual assistance" is still 0.78 in the contemporary sample, reflecting that honesty and trustworthiness have always been an important condition for cross-ethnic exchanges from ancient times to the present. The average confidence level of food culture rules (0.79) was significantly higher than that of religious ritual rules (0.64), indicating that material and cultural exchanges still constitute the basic carrier of contemporary ethnic integration.

More than 50% of all ethnic groups believed that the degree of ethnic difference was mild, and the degree of awareness of "religious belief" and "customs and habits" constituted the most significant dimension of difference, and the average degree of awareness of "customs and habits" of all ethnic groups reached 60.3%. On average, more than 90% of the respondents fully or basically agreed with the idea that all ethnic groups have advantages and should learn from and help each other, and more than 95% of the respondents regard honesty and reliability as the main first choice criterion for choosing friends.

V. B. Strategies

Based on the results of research combining historical documents and field surveys, this paper proposes a three-step ethnic interaction history and cultural integration path.

(1) Cultural Embedding by Gradient Advancement

In the process of cultural integration, it is necessary to pay attention to the protection of the development of ethnic culture, implement the cultural transition belt construction project, and establish embedded public service spaces in neighboring communities. For example, in the renovation of the old city of the region, the construction of embedded public service spaces (bilingual service stations and ethnic handicraft workshops) has promoted the frequency of daily interactions among ethnic groups. At the same time, the ethnic culture market is being developed to provide society with colorful cultural products. Finding a development model suitable for ethnic cultures under the conditions of the market economic system, motivating the public to innovate in cultural dissemination and cultural products, and giving spiritual and material rewards to groups, organizations or individuals who persist in protecting and promoting ethnic cultures.

(2) Custom-driven cultural integration

Promote multi-ethnic interaction from a custom-driven perspective to achieve cultural integration. For example, the planning and construction of ethnic integration squares, the setting up of detachable exhibition areas, and the granting of special financial subsidies for town planning, construction and maintenance provide a solid economic foundation for the integration of ethnic customs. It has formulated an interactive calendar of ethnic festivals, incorporated important celebrations of all ethnic groups into public holidays, implemented a festival rotation system, and encouraged all ethnic groups to participate in festivals and celebrations, so as to achieve the advancement of ethnic interactions in the intermingling of customs.

(3) Integrity-oriented ethnic interaction

Pilot the integrity file system, establish a system of publicizing the red and black lists of integrity, and incorporate inter-ethnic cooperation behaviors into the social credit evaluation system. Provide school-based courses on “integrity culture” in primary and secondary schools, introduce historical and cultural allusions of various ethnic groups, and cultivate honesty and trustworthiness among young people. Volunteer teams of “honesty pioneers” have been organized to carry out inter-ethnic support activities.

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