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## Trends in the Factors Causing Divorce in Semarang Raya in 2023: A Correspondence Analysis Approach

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Correspondence Analysis, Divorce, Euclidean Distance, Semarang Raya. Abstract: An ideal marriage should be the foundation for a harmonious family relationship, yet many marriages end in divorce. This study aims to identify the trend patterns of divorce causes in Semarang Raya in 2023 using correspondence analysis. The research results show that the factors causing divorce vary by region. In Semarang Raya, economic factors dominate Grobogan Regency, while forced marriage factors are more frequently found in Kendal Regency. The analysis used Euclidean distance to reinforce the findings on the relationship between the factors causing divorce in each region. These findings can be used as a basis for designing more focused divorce prevention policies in accordance with the social and economic characteristics of each region.

#### 1. INTRODUCTION

Recent social conditions indicate a decline in moral values and an increase in life pressures, resulting in a deterioration of interaction quality and harmony within marriages. In numerous nations, marriage is anticipated to function as a robust basis for family formation, thereby strengthening social connections from both cultural and religious viewpoints. A strong marriage requires commitment, affection, and a deep emotional bond to effectively navigate conflicts within the dynamics of family life [1].

Divorce is a social issue that continues to rise in regions of Semarang Raya. Based on the latest data from the Central Java Religious Court in the region, the divorce rate shows a significant increase. In Semarang Raya, which includes the city of Semarang, Semarang Regency, and its surroundings, the divorce rate is higher, with more than 15,000 divorce cases recorded in 2022, an increase of 10% compared to 2020 [2]. Most divorces in this region are also caused by continuous disputes and incompatibility between partners, with more than 70% of cases triggered by unresolved conflicts. In the Semarang Raya region, in addition to economic issues, early marriage and lack of communication between couples also contribute to the high divorce rate. The increase in divorce rates in Semarang Raya indicates a significant challenge in maintaining marital stability. In addition to affecting the couples who divorce, this phenomenon also impacts the well-being of children and the surrounding social structure.

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Unresolved conflicts, economic pressures, and changing gender roles in modern society are some of the factors that complicate the dynamics of marriage [3].

Several previous studies have used the cause of divorce data, but with different data collection methods and statistical methods. Wijayanti used the cause of divorce data with a quantitative approach involving 200 respondents and frequency distribution method with mode value, with her research results showing that the majority of divorce causes are economic factors [4]. Dalvi and Hermaleni used the cause of divorce data with a qualitative approach involving 7 respondents, consisting of 5 widows and 2 widowers, and a descriptive qualitative method. Their research results showed that the causes of divorce were infidelity, disputes, continuous arguments, economic factors, and domestic violence based on interviews with the respondents [5]. Purwaningsih and Nurelasari used the cause of divorce data with a quantitative approach, used secondary data source from the Badan Pusat Statistik of West Java Province in 2021. The research variables included adultery, drunkenness, drug use, gambling, abandonment by one party, imprisonment, polygamy, domestic violence (DV), disability, disputes, forced marriage, apostasy, and economic factors. The statistical method used was K-Means Clustering with the Davies Boulding Index (DBI). Their research results indicated that there are 7 clusters to categorize districts/cities in West Java, consisting of cluster 0 (West Java Province), cluster 1 (Tasikmalaya City), cluster 2 (Cirebon and Indramayu), cluster 3 (Tasikmalaya, Kuningan, and Subang), cluster 4 (Bogor, Cianjur, Sumedang, Karawang, and Bandung City), cluster 5 (Ciamis and Majalengka), and cluster 6 (Garut and West Bandung) [6]. Izzah, Zain, and Permatasari used the cause of divorce data with a quantitative approach, with secondary data sourced from the Badan Pusat Statistik of West Java Province in 2019. The research variables included adultery, drunkenness, drug use, gambling, abandonment by one party, imprisonment, polygamy, domestic violence (DV), disability, disputes, forced marriage, apostasy, and economic factors. The statistical method used was K-Means Clustering with the Elbow method and approached using One Way ANOVA analysis. The research results showed that there were two clusters to group districts/cities in West Java, consisting of cluster 1, which included 20 districts/cities with lower characteristics of drunkenness, drug use, gambling, abandonment by one party, polygamy, domestic violence (DV), forced marriage, and apostasy compared to cluster 2, which included 6 districts/cities [7].

Previous study descriptions often employ clustering approaches to categorize individuals or items according to divorce component characteristics, without revealing precise relationships within factor categories. The present research employs correspondence analysis to analyze divorce factors in the Semarang Raya region. This study differs from prior research in its location-based focus on the Semarang Raya area and the factors determined, such as economic issues, unilateral abandonment, domestic violence, forced marriage, apostasy, substance abuse, gambling, and persistent conflicts. This research aims at identifying the patterns and trends of divorce factors in the Semarang Raya region. This research aims to offer recommendations to the regional government of Semarang Raya to a significant decrease of divorce cases.

## 2. LITERATURE REVIEW

## 2.1. Correspondence Analysis

Correspondence theory is a multivariate statistical method that converts categorical data from a contingency table into a lower-dimensional space, typically two or three dimensions, in order to help the visualization and interpretation of inter-category interactions. This method can be beneficial for understanding the associative connections between the rows and columns of a contingency table. Correspondence analysis get started with the contingency frequency matrix  $N = n_{ij}$  which represents the joint frequency of two category variables. The contingency frequency matrix is then transformed into a proportion table  $P = [p_{ij}] = \frac{N}{n_{++}}$ , where  $n_{++}$  is the total of all observed elements in matrix N. Next, the row profile is calculated as  $R = [r_{ij}] = \frac{n_{ij}}{n_{i+}}$ , where  $n_{i+}$  is the total of elements in the i-th row. Conversely, the column profile is given by  $C = [c_{ij}] = \frac{n_{ij}}{n_{++}}$ , where  $n_{++}$  is the total of elements in the j-th column [8].

## 2.2. Independence Test

In correspondence analysis, independence refers to a situation where row and column variables do not have a significant relationship For evaluating independence, the expected value  $e_{ij}$  for each cell in the table is calculated based to the marginal distribution:

$$e_{ij} = \frac{n_{i+} \cdot n_{+j}}{n_{++}} \tag{1}$$

If the contingency table indicates a correspondence between the observed frequency  $n_{ij}$  and the expected frequency  $e_{ij}$ , the row and column variables are deemed independent. The chi-square test is commonly used to evaluate the hypothesis of independence [9].

$$\chi^2 = \sum_{i} \sum_{j} \frac{(n_{ij} - e_{ij})^2}{e_{ij}}$$
 (2)

A large  $\chi^2$  value indicates a deviation from independence.

#### 2.3. Inertia

Inertia in correspondence analysis measures the general variation in the data. It is determined by the chi-square distance between row (or column) profiles and the centroid. The total inertia can be partitioned into the contributions of each dimension in the reduced-dimensional representation. The formula for calculating total inertia is:

$$I = \sum_{i} \sum_{j} \frac{(p_{ij} - p_{i+} p_{+j})^{2}}{p_{i+} p_{+j}}$$
(3)

Where  $p_{ij}$  represents the proportion of a cell in the contingency table,  $p_{i+}$  is the total proportion of the *i*-th row, and  $p_{+j}$  is the total proportion of the *j*-th column [8].

#### 2.4. Dimension Reduction

Dimensionality reduction is a crucial step in correspondence analysis. It is performed by decomposing the correspondence matrix into several principal components using singular value decomposition (SVD). If X is the data matrix, its decomposition is given by:

$$\mathbf{X} = \mathbf{U}\mathbf{S}\mathbf{V}^T \tag{4}$$

Where S and V are orthogonal matrices that denote the row and column profiles. S is a diagonal matrix of singular values, which are the square roots of the eigenvalues representing the contribution of each dimension. Only a few components with the largest singular values are retained to simplify the data representation [8].

## 2.5. Row and Column Profile

In correspondence analysis, row profiles and column profiles represent the distribution of row and column categories relative to the total data.

The row profile for the *i*-th row is:

$$r_i = \left(\frac{n_{i1}}{n_{i+}}, \frac{n_{i2}}{n_{i+}}, \dots, \frac{n_{im}}{n_{i+}}\right) \tag{5}$$

The column profile for the *j*-th column is:

$$c_j = \left(\frac{n_{ij}}{n_{+i}}, \frac{n_{2j}}{n_{+i}}, \dots, \frac{n_{nj}}{n_{+i}}\right) \tag{6}$$

The association between categories can be measured by the distance between row and column profiles in the space created by correspondence analysis [8], [9].

## 2.6. Euclidean Distance

The Euclidean distance is a common metric used in correspondence analysis to measure the proximity between two profiles (either row or column profiles) in a multidimensional space. In correspondence analysis, Euclidean distance is used to evaluate the similarity between two profiles. Profiles with fewer Euclidean distances are considered more similar or more closely related. If two points  $A = (x_1, y_1)$  and  $B = (x_2, y_2)$  are in a two-dimensional space, the Euclidean distance is calculated as:

$$d(A,B) = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
 (7)

The smaller the distance, the closer the association between the compared categories [9].

## 2.7. Alcoholism, Drug Abuse, and Gambling

According to research [10], Article 116 of the Islamic Compilation Law (KHI) identifies alcohol consumption, gambling, and drug abuse as common grounds for divorce. These circumstances frequently result in enduring disputes within the household that remain unresolved.

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## 2.8. Leaving One Gathering

A reason for divorce is when one spouse leaves the other without an appropriate justification. This is frequently linked to the neglect of family responsibilities [10].

## 2.9. Prolonged Conflict

Prolonged, unresolved differences significantly contribute to divorce, particularly among young couples. Mir'ajun, in his research [11], investigated methods to support families in managing marital issues during the epidemic, including instances of divorce resulting from arguments.

### 2.10. Forced Marriage

Divorces due to forced marriages are more common in rural areas, where marriages are arranged by parents without considering the child's wishes. In such unions, the absence of initial affection for the partner, along with the inability to cultivate it over time, may finally result in divorce [12].

#### 2.11. Murtad

A spouse's conversion to a different religion (apostasy) can create significant difficulty in the marriage, especially if the other partner is unable to accept the new belief [13].

## 2.12. Economy

Economic instability and financial conflicts are prevalent catalysts for divorce, especially when one partner perceives financial neglect or inequitable treatment. This can lead to economic abuse, a distinct type of domestic violence (DV) in which one partner regulates the other's access to money resources [14]. According to research, indicates that economic abuse restricts a partner's capacity to acquire, utilize, and sustain financial resources, fostering financial dependence and hindering their ability to exit the relationship, perhaps culminating in divorce [15].

#### 3. METHODOLOGY

This study uses correspondence analysis, a multivariate method that transforms categorical data from a contingency table into a lower-dimensional space to assist in visualization and interpretation. The used data is from secondary data sourced from Badan Pusat Statistik (BPS) concerning the incidence of divorces categorized by their causes in the regencies and cities of Central Java Province in 2023. In this case, this study gathers data from Semarang Raya, which includes Grobogan Regency, Demak Regency, Semarang Regency, Kendal Regency, Salatiga City, and Semarang City.

The steps of analysis in this study as follows.

## 1. Data Characteristic

The first stage involves explaining the characteristics of the data related to the factors causing divorce in Semarang Raya in 2023. This analysis aims to understand the distribution and patterns within the data before conducting further statistical tests.

## 2. Calculate the Independence Test

The relationship between divorce factors and the divorce rate is analyzed using the **Chi-Square Index** method. This analysis aims to determine whether there is a significant association between the two variables. The chi-square value is calculated by comparing the observed frequencies with the expected frequencies based on the assumption of independence between categories.

#### 3. Dimensional Reduction

After calculating the Chi-Square Index, the next step is to summarize the information in the contingency table by projecting the data into fewer dimensions without losing significant information. This process, known as **dimensionality reduction**, works by extracting the principal factors that explain the most variability in the data. By doing so, relationships between categories can be visualized in a two- or three-dimensional space, making the association patterns easier to understand.

### 4. Row and Column Contributions

The next step involves analyzing row and column contributions to identify which categories play the most significant role in shaping the data structure. In **correspondence analysis**, each category (both in rows and columns) contributes to the formation of dimensions in the analysis. This contribution can be measured in terms of absolute contribution values.

## 5. Correspondence Plot

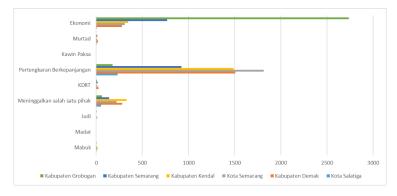
The results are then visualized in a **correspondence plot**, which illustrates the relationships between categories in a two- or multi-dimensional space. This plot helps identify patterns and associations between categories. Categories that are positioned closer in the plot have a stronger relationship compared to those that are farther apart.

#### 6. Euclidean Distance

The final step is to measure the proximity between categories in the factor space after data transformation using **Euclidean Distance**. This distance indicates how similar the frequency distribution patterns of one category are to another. The smaller the distance, the more similar the distribution patterns of the two categories in the contingency table.

#### 4. RESULTS AND DISCUSSION

### 4.1 Characteristics of Data on Factors Causing Divorce in Semarang Raya



**Fig 1**. Characteristics of Data on Factors Causing Divorce by District/City in Semarang Raya in 2023

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Figure 1 shows that in each region of Semarang Raya, which consists of the City of Semarang, the City of Salatiga, Kendal Regency, Semarang Regency, Demak Regency, and Grobogan Regency, the main causes of divorce are prolonged arguments and economic problems. Specifically, Grobogan Regency recorded the highest number of divorce cases due to economic factors, totaling 2736 cases. However, in 2023, several districts and cities in Semarang Raya did not experience significant impacts related to divorces caused by other factors such as drunkenness, drug addiction, gambling, forced marriage, and apostasy. This shows that although economic factors and prolonged arguments dominate as the causes of divorce, other social factors tend to play a smaller role in most of the regions.

## 4.2 Independence Test

The independence test on data regarding the causes of divorce in the Semarang Raya region includes factors such as drunkenness, drug addiction, gambling, abandonment of one party, domestic violence (DV), prolonged quarrels, forced marriage, apostasy, and economic issues. The Semarang Raya area includes Grobogan Regency, Demak Regency, Semarang Regency, Kendal Regency, Salatiga City, and Semarang City

Hypothesis for the Semarang Raya region:

 $H_0$ :  $P_{ij} = P_{i.} \times P_{.j}$  (There is no relationship between the factors causing divorce and the Semarang Raya region)

 $H_1: P_{ij} \neq P_{i.} \times P_{.j}$  (There is a relationship between the factors causing divorce and the Semarang Raya region)

Table 1. Independence Test Result

Variable	$\chi^{2}$	$\chi^2_{a,df}$	df	$p_{value}$	Decision
Semarang Raya Region	5635,17	55,75	40	0,000	Reject H <sub>0</sub>

Based on the  $\chi^2$  test result in Table 1, both in the Semarang Raya region ( $\chi^2 = 5635,17$ ; p < 0,05), there is a significant relationship between the causes of divorce and their respective regions. Therefore, all variables result in a decision to reject H<sub>0</sub>. This indicates that there is a significant relationship between the factors causing divorce and the Semarang Raya region.

#### 4.3 Correspondence Analysis

#### 4.3.1 Dimensional Reduction

Table 2. Dimensions Reduction of Divorce Causes by District/City in Semarang Raya

Dimension	Inertia	Proportion	Cumulative Proportion
1	0,463	0,975	0,975
2	0,007	0,015	0,989
3	0,003	0,007	0,997
4	0,001	0,002	0,999
5	0	0,001	1

Table 2 provides information that dimension 1 has an inertia value of 0.463 and explains 97.5% of the data variance, making it the most dominant dimension in explaining the variation in divorce factors in Semarang Raya.

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#### 4.3.2 Contribution from Row Profile

**Table 3**. The Absolute and Relative Contribution Values of Rows for Districts/Cities in Semarang Raya

Dagion	Absolute Contribution		Relative Contribution		
Region	Dimension 1	Dimension 2	Dimension 1	Dimension 2	
Grobogan Regency	0,679	0	1	0	
Demak Regency	0,097	0,032	0,965	0,005	
Semarang Regency	0,002	0,012	0,483	0,043	
Kendal Regency	0,079	0,352	0,909	0,061	
Salatiga City	0,030	0,053	0,905	0,024	
Semarang City	0,114	0,551	0,925	0,0	

Table 3 explains that the Semarang Raya region included in dimension 1 is Grobogan Regency, which accounts for 67.9% of data diversity, as well as Demak Regency with a contribution of 9.7%. Meanwhile, the Semarang Raya area that falls within dimension 2 includes the city of Semarang, which explains 55.1% of the data variance, Kendal Regency with 35.2%, Salatiga City with 5.3%, and Semarang Regency with 1.2%. Table 9 also shows the dominance of dimensions in the Semarang Raya region, where dimension 1 is fully dominated by Grobogan Regency at 100%, while dimension 2 is dominated by Kendal Regency with a contribution of 6.1%.

#### 4.3.3 Contribution from Column Profile

**Table 4**. The Absolute and Relative Contribution Values of Columns for Factors Causing Divorce in Semarang Raya

	Absolute Contribution		Relative Contribution		
	Dimension 1	Dimension 2	Dimension 1	Dimension 2	
Alcoholism	0,001	0,043	0,302	0,244	
Drug Abuse	0	0,003	0,270	0,035	
Gambling	0	0,104	0,089	0,396	
Leaving one spouse	0,046	0,705	0,810	0,187	
Domestic Violence	0,001	0,029	0,227	0,091	
Prolonged Conflict	0,323	0,083	0,996	0,004	
Forced Marriage	0	0,033	0,306	0,505	
Murtad	0,003	0	0,521	0,001	
Economy	0,625	0	1	0	

Table 4 explains that the factors causing divorce included in dimension 1 are economic factors, which account for 62.5% of data variance, followed by arguments at 32.3%, and apostasy at 0.03%. The factors causing divorce that fall under dimension 2 include abandonment by one party, which accounts for 70.5% of data variance, gambling at 10.4%, domestic violence at 2.9%, drunkenness at 4.3%, forced marriage at 3.3%, and drug addiction at 0.3%. Table 10 also shows the dimensions that tend to dominate the factors causing divorce, where dimension 1 is dominated by the economy with 100%, while dimension 2 is dominated by forced marriage with 50.5%.

#### 4.3.4 Correspondence Plot

The visualization of the correspondence plot is necessary by determining the coordinate point values of the row and column profiles to identify the distribution patterns of divorce causative factors by district/city. Here are the results of the row and column profile coordinate values used to create the correspondence plot in Table 5 and Table 6.

Table 5. Row Profile Coordinate Points for Districts/Cities in Semarang Raya

Wileyeh	Score in Dimension			
Wilayah	Dimension 1	Dimension 2		
Grobogan Regency	1,353	-0,011		
Demak Regency	-0,607	-0,123		
Semarang Regency	0,092	0,078		
Kendal Regency	-0,541	-0,401		
Salatiga City	-0,893	-0,418		
Semarang City	-0,619	0,477		

Table 6. Column Profile Coordinate Points for Districts/Cities in Semarang Raya

	Score in Dimension			
	Dimension 1	Dimension 2		
Alcoholism	-0,451	1,156		
Drug Abuse	-0,898	0,921		
Gambling	-0,361	2,171		
Leaving one spouse	-0,585	-0,800		
Domestic Violence	-0,347	0,629		
<b>Prolonged Conflict</b>	-0,651	0,116		
Forced Marriage	-0,904	3,310		
Murtad	-0,700	0,068		
Economy	1,065	0,003		

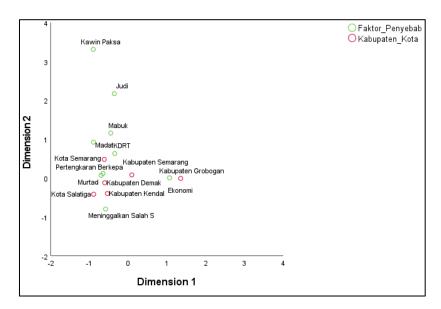


Fig 2. Correspondence Plot of Divorce Causes by Regency/City in Semarang Raya in 2023

The trend pattern of divorce causative factors by district/city in Semarang Raya in 2023 is visualized in Figure 2, where the small green circles represent the divorce causative factors and the small red circles depict the district/city variables. The analysis results show a significant relationship between the causal factors and the analyzed districts/cities. For example, Semarang Regency and Kendal Regency are quite close to the "Economic" factor, indicating that the economic factor plays an important role in the dynamics of divorce in both regions. On the

other hand, Grobogan Regency and Semarang Regency are closer to social issues, such as "Gambling" and "Alcoholism," which better reflect the social characteristics of the region. More specific factors such as "Leaving One spouse" appear to be far removed from any district/city, indicating that this factor is less relevant or rarely occurs in the analyzed area. The proximity of points on this correspondence plot provides important insights into the relationship between causal factors and districts/cities, which can be used as a basis for designing more targeted and relevant policies or interventions according to the characteristics of each area. Additionally, the results of the correspondence plot visualization are also supported by the Euclidean distance calculations presented in Table 7, which provide further information about the proximity and relationships between the analyzed variables.

#### 4.3.5 Euclidean Distance

Table 7. Euclidean Distance for Divorce Cause Factors by Regency/City in Semarang Raya

	Grobogan	Demak	Semarang	Kendal	Salatiga	Semarang
	Regency	Regency	Regency	Regency	City	City
Alcoholism	2,149	1,288	1,207	1,560	1,635	0,699
Drug Abuse	2,436	1,084	1,300	1,369	1,339	0,524
Gambling	2,775	2,307	2,141	2,578	2,643	1,714
Leaving one spouse	2,092	0,677	1,109	0,401	0,491	1,277
Domestic Violence	1,816	0,796	0,705	1,048	1,181	0,312
Prolonged Conflict	2,008	0,243	0,744	0,529	0,586	0,362
Forced Marriage	4,015	3,446	3,382	3,729	3,728	2,847
Murtad	2,055	0,212	0,792	0,495	0,523	0,417
Economy	0,288	1,677	0,976	1,656	2,003	1,749

Table 7 shows the calculation of the Euclidean distance between the causes of divorce and the districts/cities in Semarang Raya. A smaller distance indicates a closer and stronger relationship between the causal factors and specific regions. For example, Semarang City has the smallest distance for the factors "Drunkenness" (0.699) and "Domestic Violence" (0.312), indicating that these issues are more dominant in that city. On the other hand, Grobogan Regency has the largest distance for the factors "Forced Marriage" (4.015) and "Gambling" (2.775), indicating that these factors are less relevant in the region. Demak Regency, on the other hand, has the smallest distance for the factors "Apostasy" (0.212) and "Prolonged Quarrels" (0.243), indicating a higher relevance of these factors in this area.

### 5. CONCLUSION

Based on the analysis of the trend patterns of divorce causes in Semarang Raya in 2023, the main causes of divorce are prolonged arguments and economic problems, with Grobogan Regency recording the highest number of divorce cases caused by economic factors. Nevertheless, several districts and cities in this region do not experience significant impacts from other divorce causes, such as drunkenness, drug addiction, gambling, forced marriage, and apostasy. The results of the correspondence analysis and Euclidean distance calculations show a significant relationship between the causes of divorce and the analyzed districts/cities.

For example, Semarang Regency and Kendal Regency are more closely associated with the "Economic" factor, while Grobogan Regency and Semarang Regency are more related to social factors such as "Gambling" and "Drunkenness." These findings provide important insights into the variations in the factors causing divorce in each region, which can serve as a basis for formulating more focused policies to address divorce in each area.

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