Identification of Spatial Autocorrelation in Cases of Complaints About Illegal Online Loans in Indonesia

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Abstract

The development of digital financial services has made it easier for people to access technology-based loans, but this has also been accompanied by an increase in illegal online lending practices, which have generated numerous complaints from consumers in various regions. This situation indicates the potential for uneven distribution of cases across regions. This study aims to identify interregional spatial relationships in data on the number of complaints about illegal online loans across provinces in Indonesia. This study uses data on the number of complaints about illegal online loans from January to June 2025. The analytical methods used include descriptive statistics, the Moran Index to measure global spatial autocorrelation, and the Local Indicator of Spatial Autocorrelation (LISA) to detect local clusters. The results show positive spatial autocorrelation, where provinces with a high number of complaints tend to be close to each other, particularly areas with high levels of urbanization and digital activity such as DKI Jakarta, West Java, Central Java, and Banten. Thus, the distribution of complaints about illegal online loans is not random but is influenced by geographic proximity and regional socioeconomic characteristics.

Keywords: keyword 1; illegal online loans 2; spatial autocorrelation 3; Morans I 4; LISA

Abstrak

Perkembangan layanan keuangan digital telah memudahkan masyarakat dalam mengakses pinjaman berbasis teknologi, namun hal ini juga diikuti oleh meningkatnya praktik pinjaman online ilegal yang menimbulkan banyak pengaduan dari konsumen di berbagai daerah. Kondisi tersebut menunjukkan adanya potensi pola persebaran kasus yang tidak merata antarwilayah. Penelitian ini bertujuan mengidentifikasi adanya hubungan spasial antarwilayah pada data jumlah pengaduan pinjaman online ilegal antarprovinsi di Indonesia. Penelitian ini menggunakan data jumlah pengaduan pinjaman online ilegal periode Januari hingga Juni 2025. Metode analisis yang digunakan meliputi statistik deskriptif, Indeks Moran untuk mengukur autokorelasi spasial global, serta Local Indicator of Spatial Autocorrelation (LISA) untuk mendeteksi klaster lokal. Hasil penelitian menunjukkan adanya autokorelasi spasial positif, di mana provinsi dengan jumlah pengaduan tinggi cenderung berdekatan satu sama lain, khususnya wilayah dengan tingkat urbanisasi dan aktivitas digital yang tinggi seperti DKI Jakarta, Jawa Barat, Jawa Tengah, dan Banten. Dengan demikian, persebaran pengaduan pinjaman online ilegal tidak terjadi secara acak, tetapi dipengaruhi oleh kedekatan geografis dan karakteristik sosial ekonomi wilayah.

Kata Kunci: kata kunci 1; pinjaman online ilegal 2; autokorelasi spasial 3; Morans I 4; LISA

1. INTRODUCTION

Technological developments have made it easier for people to access online financial services (financial technology) (Aini & Fadilla, 2024). The scope of Fintech encompasses various financial aspects, one of the main areas being digital banking, such as account opening, transactions, and financial management without physical branches. Electronic payments through digital wallets, cards, and mobile payments are also crucial in supporting cashless transactions. Peer-to-peer lending business models, which can provide loans without traditional intermediaries, have opened up access to financing for many who struggle to obtain support from conventional financial institutions (Zulfa et al., 2024).

The rapid growth of Fintech, particularly in online lending services, has driven various innovations in digital financial services in Indonesia. The rise in online lending practices is due to various factors, such as increasingly advanced technological infrastructure, internet network availability, massive online loan promotion, and easy access for people of all ages.

According to the Consumer Protection Monthly Statistics Report (PEPK) published on the official website of the Financial Services Authority (OJK), there were 16,594 public complaints regarding illegal online loans filed through official channels, such as the Consumer Protection Portal (APPK) application and the 157 contact service. The report indicates that the highest number of complaints came from West Java Province (3,567), followed by Jakarta Province (2,298), East Java Province (2,028), Banten Province (1,335), and Central Java Province (1,440). These figures indicate that the distribution of illegal online loan complaints is uneven across Indonesia and tends to be concentrated in provinces with high levels of urbanization and digital economic activity. This finding aligns with research (Hasibuan & Hasibuan, 2021), which shows that socioeconomic phenomena, such as poverty, can shape spatial patterns across regions.

This study aims to analyze the distribution pattern of the number of complaints about illegal online loans between provinces in Indonesia using the Morans Index Approach (Moran's I) to measure the level of spatial autocorrelation globally, as well as the Local Indicator of Spatial Autocorrelation (LISA) to see local cluster patterns at the provincial level. The benefits and contributions of this research include increasing literacy and awareness of online loan risks within the community. The government can also develop policies and educational advertisements to prevent financial and social losses.

2. RESEARCH METHODS

This study uses data on the number of complaints about illegal online loans in Indonesia from January to July 2025. The data was obtained from the Financial Services Sector

Consumer Complaints Statistics Report and annual reports available on the official OJK website.

The data analysis technique in this study employed descriptive statistics and spatial analysis using the Moran Index (Moran's I) and the Local Indicator of Spatial Autocorrelation (LISA). The following are the analysis steps:

1. Describe the number of complaints about illegal online loans in Indonesia from January to July 2025 using descriptive statistics and spatial mapping to illustrate the distribution of cases in each province.
2. Calculate the Spatial Weighting Matrix using Queen Contiguity, based on the sides and corners of each neighbor, assigning a value of 1 (one) to adjacent neighbors and a value of 0 (zero) to non-adjacent neighbors.
3. Calculate the standardized spatial weighting matrix using equation

$$W_{ij} = \frac{w_{ij}'}{\sum_{j=1}^{n} w_{ij}'}$$ (1)

(Baskara et al., 2024).

4. Calculate the Moran's index value for illegal online loan complaint data in Indonesia using equation.

$$I = \frac{n \sum_{i=1}^{n} \sum_{i=1}^{n} w_{ij}(x_i - \overline{x})(x_j - \overline{x})}{\sum_{i=1}^{n}(x_i - \overline{x})^2}$$ (2)

(Hadisti et al., 2024).

5. Create a Moran's scatterplot and a thematic map based on the results of the Moran's scatterplot.
6. Calculate the LISA index value using equation.

$$I_i = \frac{z_i}{m_2} \sum_{j=1}^{n} W_{ij} Z_j$$ (3)

(Hutapea et al., 2025).

7. Create a thematic map based on the results of the LISA and Moran's scatterplot tests.

3. RESULT AND DISCUSSION

3.1 Descriptive Statistics

The results of descriptive statistical processing of data on complaints of illegal online loans in Indonesia for the period January to June 2025 can be seen in the table 1.

Table 1. Descriptive Statistics

Minimum	Maximum	Mean	Std. dev
8	3.567	427	745

Based on Table 1, descriptive statistics show that the minimum number of complaints was 8, while the maximum number reached 3.567. The average number of complaints from all over Indonesia reached 427, and the standard deviation value was 745. This indicates that the larger the standard deviation value, the more dispersion the data has from the average. With a fairly wide range between the minimum and maximum values, this indicates significant variation, namely a fairly large difference in the number of complaints between provinces. Therefore, when visualized through the following picture 1.
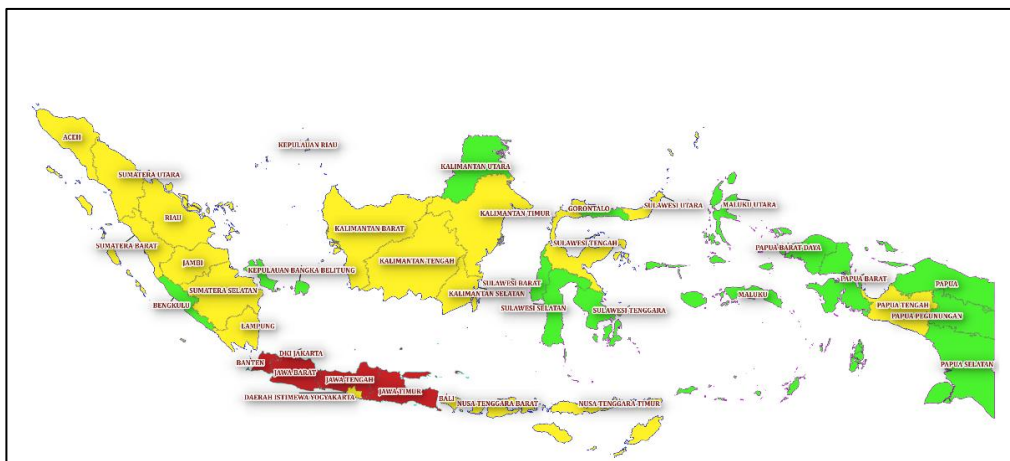

Figure 1. Spatial Mapping Of The Number Of Complaints About Illegal Online Loans in Indonesia in The Period January to June 2025 By Province

The figure 1 shows that, the distribution of complaints is uneven across provinces. The provinces with the highest number of complaints are located on the island of Java, namely West Java, Jakarta, East Java, Central Java, and Banten, while eastern regions such as Papua, Maluku, and Nusa Tenggara show a relatively low number of complaints. These results indicate that the distribution of illegal online loan complaints is uneven across Indonesia and tends to be concentrated in provinces with high levels of urbanization and digital economic activity.

This condition aligns with research conducted by Deborah et al. (2022) in West Java. The study found that high internet and social media usage, such as Instagram and TikTok, has driven lifestyle changes and shaped more hedonic and impulsive consumption patterns. Consumers in this region tend to make unplanned purchases, influenced by hedonic shopping motivation and oriented towards emerging trends on social media. Research by Kurniasih (2023) conducted in Serang City showed that a hedonic lifestyle

significantly influences consumer behavior, and easy access to online loans reinforces this tendency. This shows that when an individual has a high level of hedonism, they will tend to spend excessively to meet their needs.

3.2 Morans I

Table 2. Morans I

Morans (I)	*p-value*
0,7163	$4,828 \times 10^{-8}$

Based on table 2, the p-value shows that there is spatial autocorrelation in the data on Illegal Online Loan Complaints in each province in Indonesia for the period January to June 2025, while from the Moran index, the number of illegal online loan complaints in Indonesia for the period January to June 2025 is in the range of $0 < I \le 1$, this indicates a positive spatial autocorrelation, meaning that each adjacent province has almost the same number of complaints. In addition, the results of the analysis show that provinces with high and low numbers of illegal online loan complaints tend to cluster, or in other words, areas with similar characteristics tend to be close to each other.

Apart from using the Moran index value, spatial relationships between regions can also be analyzed visually using Moran's Scatter Plot.
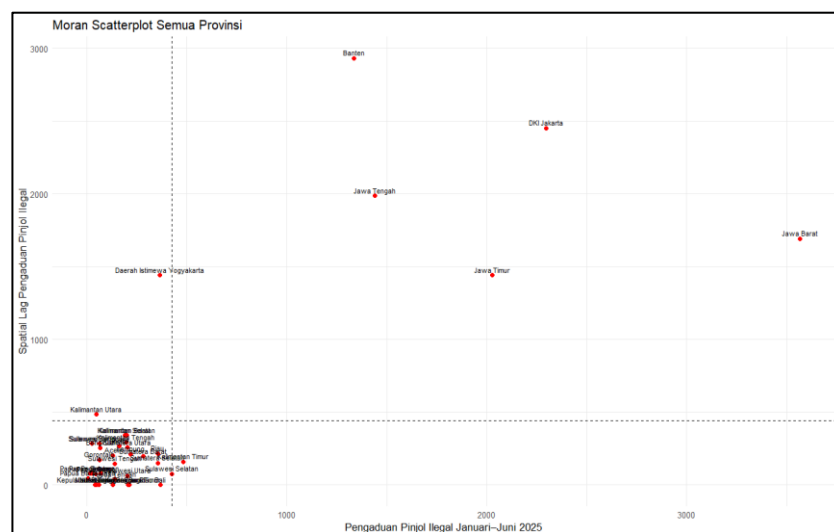

Figure 2. Moran's Scatter Plot

Based on Figure 2, it can be seen that Quadrant I consists of 5 provinces, Quadrant II consists of 3 provinces, Quadrant III consists of 4 provinces and Quadrant 4 consists of 2 provinces.
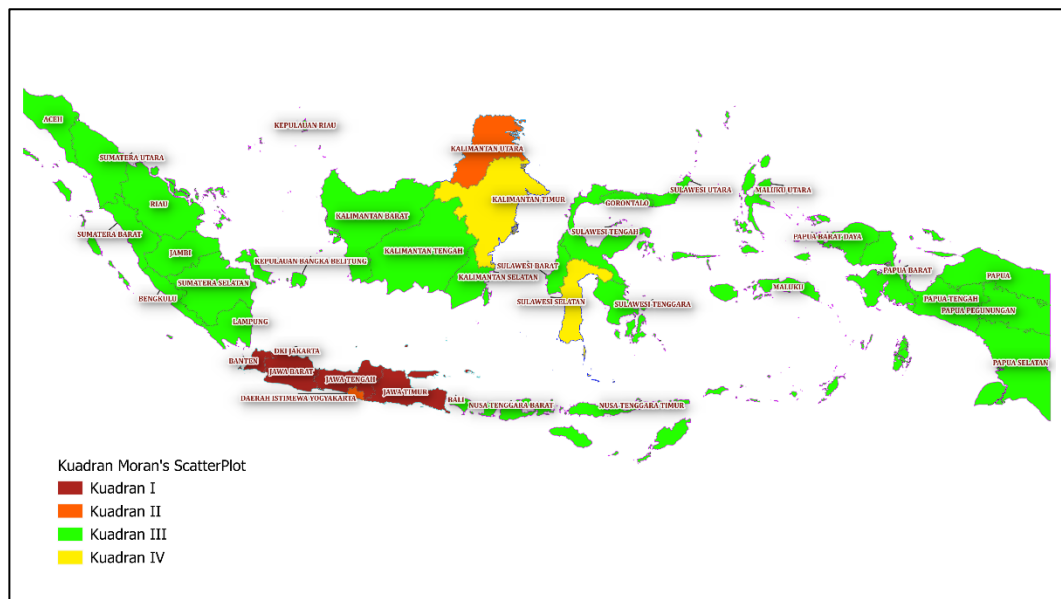
Figure 3. Spatial Mapping based on Morans scatterplot

Figure 3. The map illustrates the spatial distribution of illegal online loan complaints in Indonesia during the period January-June 2025, grouped according to Moran's I quadrant as follows:

1. Quadrant I (High-High), marked in dark red, indicates areas with a high number of illegal online loan complaints surrounded by areas with a similarly high number of complaints. Areas included in this quadrant include DKI Jakarta, West Java, Central Java, East Java, and Banten.
2. Quadrant II (Low-High), marked in orange, depicts areas with a low number of complaints but adjacent to areas with a high number of complaints. Examples include the Special Region of Yogyakarta and North Kalimantan.
3. Quadrant III (Low-Low), marked in green, depicts areas with a low number of complaints surrounded by areas with a similarly low number of complaints. Most provinces in Sumatra, Kalimantan, and Eastern Indonesia fall into this group.
4. Quadrant IV (High-Low), marked in yellow, depicts regions with a high number of complaints but surrounded by regions with low complaints, including East Kalimantan and South Sulawesi.

Moran's scatterplot shows autocorrelation between provinces with high levels of illegal online loan complaints, particularly on the island of Java, indicating that these regions tend to form a clustered pattern in the distribution of cases.

3.2 Local Indicator of Spatial Autocorrelation (LISA)
Spatial autocorrelation testing using LISA shows local relationships within each province in Indonesia. The following are the results of the LISA test for data on Illegal Online Loan Complaints in Indonesia for the period January-June 2025.

Table 3. LISA Index

Province	LISA Index	*p-value*
DKI Jakarta	7,009531	$1{,}09 \times 10^{-5}$
Banten	4,211049	$6{,}52 \times 10^{-7}$
Jawa Tengah	2,925133	$9{,}64 \times 10^{-5}$
⋮	⋮	⋮
Jawa Barat	7,346531	$5{,}80 \times 10^{-6}$

Based on the table above, it is known that several provinces that have local spatial autocorrelation are DKI Jakarta, Banten, Central Java, and West Java in the data on complaints of illegal online loans in Indonesia for the period January-June 2025.
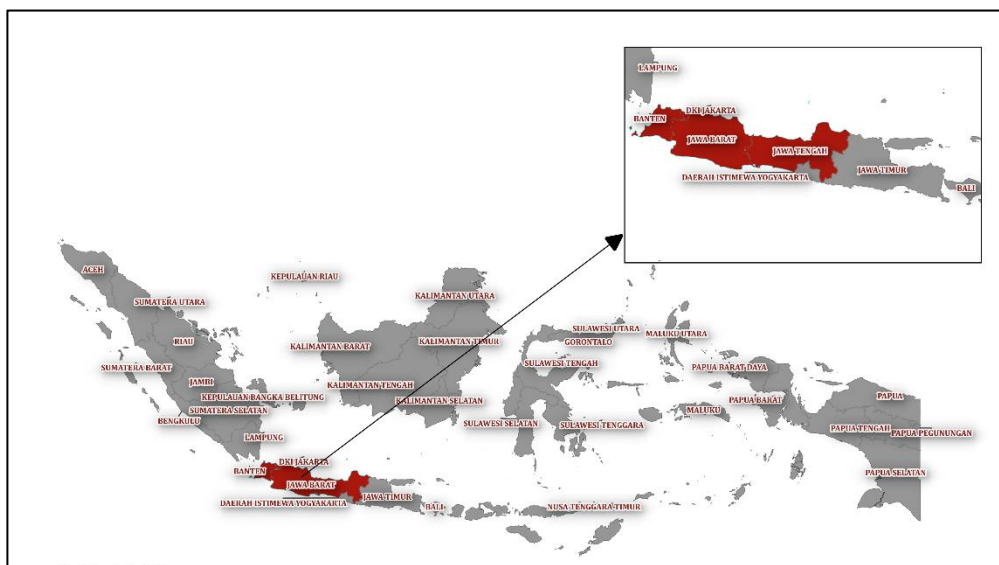

Figure 4. Spatial mapping based on LISA analysis

Based on Figure 4, areas shaded in red indicate significant local spatial autocorrelation. Meanwhile, areas shaded in gray indicate no significant local spatial autocorrelation. The significant provinces are Banten, DKI Jakarta, West Java, and Central Java. The map shows that these significant areas fall within quadrant I (High-High). This indicates that the distribution of illegal online loan complaints in Indonesia from January to June 2025 is highly significant in areas within quadrant I, with a tendency to cluster in adjacent areas and areas with a high number of online loan complaints.

This aligns with data from the Central Statistics Agency (BPS), which shows DKI Jakarta has the highest urbanization rate in Indonesia, followed by West Java. It also aligns with GoodStats (2024) findings that indicate these four provinces are among the top 10 provinces with the highest digital competitiveness. Therefore, it can be concluded that

regions with high urbanization and digital economic activity tend to exhibit a greater concentration of illegal online loan complaints.

4. CONCLUSION

This study aimed to identify the spatial distribution patterns of complaints regarding illegal online loans across provinces in Indonesia using Moran's Index and Local Indicators of Spatial Autocorrelation (LISA). The results indicate the presence of positive spatial autocorrelation, meaning that neighboring provinces tend to exhibit similar levels of complaints. The clustering pattern shows that provinces with high numbers of complaints are concentrated in regions with high levels of urbanization and digital economic activity, particularly on the island of Java. Provinces such as DKI Jakarta, West Java, Central Java, and Banten fall into the High-High cluster, reflecting a significant concentration of complaints in adjacent high-complaint areas. In contrast, provinces with lower complaint levels are predominantly located in regions with more limited digital access and lower financial technology engagement. Therefore, the distribution of illegal online loan complaints is not random but is influenced by regional proximity and socio-economic factors related to digitalization and consumer lifestyle behavior.

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