Verifying Rule: 2. The account holder name must be consistent across records with the same account number
Cur_type: Payment Details

Verification Process:
Step 1: Decompose the rule and extract the fields mentioned in the rule:
Account Number, Account Holder Name

Step 2: Focus on the structured text extracted from the **Fact Repository** and

```
records:
  - record_id: 1
    account_holder_name: Jinan Huaiyin East and Hardware Store
    payment_account_number: 37592846

  - record_id: 2
    account_holder_name: Jinan Huaiyin East and Hardware Store
    payment_account_number: 37592846

  - record_id: 3
    account_holder_name: Jinan Huaiyin Youxi Dry Cleaning Store
    payment_account_number: 672703124

  - record_id: 4
    account_holder_name: Jinan Huaiyin Youxi Dry Cleaning Store
    payment_account_number: 672703124
```

Step 3: Analyze whether the extracted structured text matches the content described in the rule:
Analysis:
- Record ID 1 and Record ID 2 share the same payment account number (37592846), and the account holder name is Jinan Huaiyin East and Hardware Store for both.
- Record ID 3 and Record ID 4 share the same payment account number (672703124), and the account holder name is Jinan Huaiyin Youxi Dry Cleaning Store for both.

After analysis, all records with the same account number also have consistent account holder names. The relationships between fields in the structured text match the rule as described. Therefore, the rule is valid and should be retained.

Step 4: Based on the analysis, the output is as follows:
Conclusion Summary: Retain

Verifying Rule: 3. The transaction amount must be identical for records with the same account number
Cur_type: Payment Details

Verification Process:
Step 1: Decompose the rule and extract the fields mentioned in the rule:
Account Number, Amount

Step 2: Focus on the structured text extracted from the **Fact Repository** and

```
records:
  - record_id: 1
    payment_account_number: 37592846
    amount: 10.00

  - record_id: 2
    payment_account_number: 37592846
    amount: 10.00

  - record_id: 3
    payment_account_number: 672703124
    amount: 20.00

  - record_id: 4
    payment_account_number: 672703124
    amount: 23.00
```

Step 3: Analyze whether the extracted structured text matches the content described in the rule:
Analysis:
- For Payment Account Number 37592846, both Record ID 1 and Record ID 2 have the same amount of 10.00.
- For Payment Account Number 672703124, Record ID 3 has an amount of 20.00, while Record ID 4 has an amount of 23.00.

After analysis, the samples with Payment Account Number <37592846> have consistent amounts, but the samples with Payment Account Number <672703124> have inconsistent amounts. Therefore, the relationships between the fields in the structured text do not align with the rule.

Step 4: Based on the analysis, the output is as follows:
Conclusion Summary: Discard

Rules 4-8 follow the same rule verification steps. After verification by the fact repository, the rules that are consistent with the patterns observed in normal samples. The following are all the rules that have been retained:

Rule Verified:
1. Records sharing the same account number must have identical addresses.
2. The account holder name must be consistent across records with the same account number.
4. Records associated with the same account number must maintain uniform status.
8. The company name must be uniform across all records sharing the same account number.

(d) Rule-Based Anomaly Detection

Analysing Rule: 1. Records sharing the same account number must have identical addresses

Analysis Process:
Step 1: Rule Analysis
The rule states that if multiple electricity bill records share the same account number, the addresses for these samples must be identical. The relevant fields are **<Account Number>** and **<Address>.**

Step 2: Analysis of given Structured Texts
The content relevant to the above fields is extracted as follows:

```
records:
  - record_id: 1
    account_number: 8123531476000
    address: "No. 88, Jianguo Road, Chaoyang District, Inner Mongolia"

  - record_id: 2
    account_number: 8123531476000
    address: "No. 100, Shiji Avenue, Meizhou City, Guangdong Province"

  - record_id: 3
    account_number: 8123531476000
    address: "Building T3, Southern Section, Science and Technology Park, Nanshan Distric

  - record_id: 4
    account_number: 4829374651023
    address: "No. 4, Floor 123, Block A, Kejihuayuan, No. 6 Yuejin Road, Fucheng District
```

Step 3: Verification of Rule Violation
Records 1,2 and 3 share the same account number, <8123531476000>, but the addresses differ.

Step 4: Analysis Result Output
- **Conclusion:** Violation of rule "Records sharing the same account number must have identical addresses".
- **Affected records:** [1, 2, 3]
- **Explanation:** All account numbers are < 8123531476000 >, but the addresses are <No.88 Jianguo Road…>, <No.100 Shiji Avenue…>, <Building T3, Southern Section…>, respectively.

Conclusion Summary: Anomaly

(e) Fact-Driven Anomaly Verification

Verifying Anomaly: Violation of the **rule** *<If multiple electricity bill records share the same account number, the addresses for these samples must be identical>*. **Affected records**: [1, 2, 3]. **Explanation**: All account numbers are < 8123531476000 >, but the addresses are <No.88 Jianguo Road…>, <No.100 Shiji Avenue…>, <Building T3, Southern Section…>, respectively.

Verification Process:
Step 1: Confirm whether the fields are faithful to the original text
Fields by explanation:

```
records:
  - record_id: 1
    account_number: 8123531476000
    address: "No. 88, Jianguo Road, Chaoyang District, Inner Mongolia"

  - record_id: 2
    account_number: 8123531476000
    address: "No. 100, Shiji Avenue, Meizhou City, Guangdong Province"

  - record_id: 3
    account_number: 8123531476000
    address: "Building T3, Southern Section, Science and Technology Park, Nanshan Distric
```