

# Transaction Fraud and Risk Analysis

This analysis examines 24 million transaction records to identify fraud patterns, behavioural anomalies, and credit risk indicators across users, merchants, and cards. SQL was used to perform large-scale aggregations and windowed calculations to support fraud detection and risk management decisions.

---

## Questions

- How does fraud risk vary when users' daily spending exceeds their own 30-day rolling average?
  - Which merchant cities have the highest fraud rates?
  - Which merchants have the highest fraud rate?
  - How does fraud differ based on transaction type?
  - How many credit cards fall into utilisation bands based on average monthly spend versus credit limit?
  - For each user, what percentage of total spend goes to their top merchant?
-

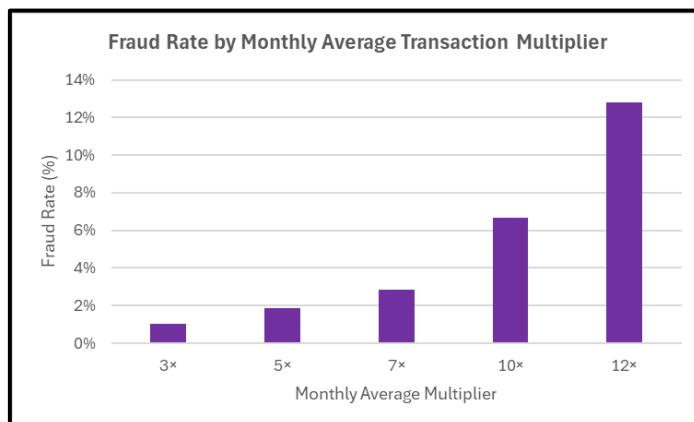
## How does fraud risk vary when users' daily spending exceeds their own 30-day rolling average?

### Findings

This analysis examines days on which a user's total transaction value exceeds their own 30-day rolling average by increasing multipliers (3×–12×).

- As the multiplier increases, the number of qualifying days and transactions declines sharply, indicating that extreme spending behaviour is rare.
- However, the likelihood that these days include fraudulent transactions increases significantly at higher multipliers.
- Large deviations from a user's normal spending behaviour are strongly correlated with elevated fraud risk.

Multiplier	Total Days	Fraud Days
3×	211,381	2209
5×	40,469	752
7×	11,628	332
10×	1,225	82
12×	375	48



### Action

Implement a fraud-monitoring rule that flags days where a user's total transaction value exceeds seven times their own 30-day rolling average. This threshold balances fraud detection effectiveness, enabling risk teams to prioritise high-risk anomalies while minimising false positives.

## Which merchant cities have the highest fraud rates?

### Findings

- 32 merchant cities have a 100% fraud rate.
- Funafuti is the only merchant city with a 100% fraud rate and more than two transactions, warranting immediate investigation.
- 63 merchant cities exhibit approximately 0% fraud rates.
- Funafuti-specific observations:
  - All transactions were swipe transactions.
  - Most transactions occurred between 10 PM and 4 AM
  - Average transaction value was approximately \$75.
  - 32 consumers were affected.
  - Fraud activity was concentrated across 13 merchants.

AZ merchant_city	123 total_fraud_transaction	123 total_transactions	123 fraud_rate
Funafuti	59	59	100
Algiers	629	654	96.18
Green Springs	18	21	85.71
Port au Prince	375	446	84.08
Suva	32	40	80
Abuja	143	233	61.37
Istanbul	257	472	54.45
Rome	4,683	13,765	34.02
Mooresburg	6	22	27.27
Ernul	5	22	22.73

### Action

Merchants operating in Funafuti should be investigated immediately, as the 100% fraud rate combined with concentrated nighttime activity may indicate coordinated or automated fraud operations. Further analysis should confirm whether affected consumers are geographically concentrated in Funafuti to assess potential geographic targeting.

123 merchant_name	123 count
-8,477,126,181,312,730,812	6
-7,528,487,659,282,641,445	2
-5,849,518,790,565,023,226	10
-3,133,641,902,015,956,065	2
-1,778,606,849,438,853,744	5
1,617,229,692,886,625,283	6
2,576,662,850,920,049,383	6
2,780,496,344,073,170,648	2
2,786,098,119,243,931,536	1
4,953,610,444,122,815,890	5
5,927,537,557,379,097,933	3
8,005,243,789,326,927,028	2
8,057,895,365,347,174,748	9

## Which merchants have the highest fraud rate?

### Findings

- 731 merchants have a 100% fraud rate.
- 94 merchants have a 100% fraud rate with more than one transaction, indicating repeated fraudulent activity.
- 2,811 merchants have experienced at least one fraudulent transaction.
- The top 10 merchants with a 100% fraud rate are ranked by transaction volume in the table below.

### Action

These merchants should be investigated immediately, as high fraud rates combined with repeated transaction activity suggest potential merchant misuse or systemic issues. Early intervention can reduce consumer exposure and prevent further losses.

Rank	Merchant Name	Total Fraud Transactions	Total Transactions	Fraud Rate (%)
1	-7,231,389,139,399,574,921	148	148	100
2	3,897,876,142,681,371,300	55	55	100
3	-563,157,518,771,065,152	53	53	100
4	-5,674,292,871,952,204,677	36	36	100
5	860,447,638,725,616,284	34	34	100
6	-8,291,617,834,869,479,558	19	19	100
7	938,055,602,653,740,367	18	18	100
8	-9,009,228,730,649,086,683	16	16	100
9	6,266,551,787,501,921,294	15	15	100
10	-4,117,079,033,496,807,984	14	14	100

---

## How does fraud differ based on transaction type?

### Findings

- 4,836 fraudulent transactions occurred via chip.
- 18,349 fraudulent transactions occurred via online transactions.
- Online transactions exhibit the highest fraud rate, approximately 8× higher than chip transactions, which rank second.
- 61% of all fraud incidents occurred in online transactions.

AZ use_chip	123 total_fraud_per_transaction_type
Online Transaction	61.66
Swipe Transaction	22.09
Chip Transaction	16.25

AZ use_chip	123 total_fraud_transactions	123 total_transactions	123 fraud_per_transaction_type
Online Transaction	18,349	2,713,220	0.68
Chip Transaction	4,836	6,287,598	0.08
Swipe Transaction	6,572	15,386,082	0.04

### Action

Enhanced security controls should be prioritised for online transactions, where fraud risk is disproportionately high. In parallel, targeted consumer education initiatives should be introduced to improve awareness of safe online transaction practices and reduce fraud susceptibility.

---

## How many credit cards fall into utilisation bands based on average monthly spend versus credit limit?

### Findings

- 1,681 distinct credit cards were used during the analysis period (last 12 months).
- 81% of credit cards remained under 30% utilisation on a monthly average.
- 3% of credit cards were near their credit limit on a monthly average.

AZ spending_bracket	123 count
0-30	1,371
30-60	221
60-90	38
90+	51

### Action

Identify if there are users holding multiple credit cards with sustained utilisation above 90%, as this pattern may indicate elevated default or financial stress risk.

---

## For each user, what percentage of total spend goes to their top merchant?

### Findings

- One user spent over 80% of total transaction value at a single merchant.
- 69 users spent more than 50% of their total spend at one merchant.
- 13 users spent over \$1,000,000 at a single merchant.

123 trans_user	123 merchant_name	123 mcc	123 amount_spent_at_top_merchant	123 total_spent	123 percentage_amount_spent_at_top_merchant
1,431	-5,920,216,026,753,360,007	4,111	1,050,032.85	1,286,837.27	81.6
910	-4,282,466,774,399,734,331	4,829	1,330,899.71	1,899,265.41	70.07
1,983	-4,282,466,774,399,734,331	4,829	1,327,435.5	1,930,813.14	68.75
806	-4,282,466,774,399,734,331	4,829	1,767,264.71	2,694,361.37	65.59
486	-4,282,466,774,399,734,331	4,829	2,912,829.07	4,595,219.81	63.39
1,287	-4,282,466,774,399,734,331	4,829	1,175,856.25	1,961,320.96	59.95
1,911	-4,282,466,774,399,734,331	4,829	1,013,232.05	1,786,743.66	56.71
699	-4,282,466,774,399,734,331	4,829	1,091,875.38	2,000,973.23	54.57
1,671	-4,282,466,774,399,734,331	4,829	1,371,143.32	3,456,343.45	39.67
808	-5,162,038,175,624,867,091	5,541	1,024,028.18	2,724,691.98	37.58
1,080	1,799,189,980,464,955,940	5,499	1,231,990.17	3,589,482.3	34.32
332	1,799,189,980,464,955,940	5,499	1,231,681.36	3,986,108.99	30.9
1,150	2,027,553,650,310,142,703	5,541	1,196,594.99	5,048,758.73	23.7

### Action

Analyse which merchant category codes (MCCs) dominate high spend concentration to identify categories where users allocate most of their spending, informing both risk exposure and customer behaviour insights.

123 mcc	123 mcc_count_by_user_top_merchant
5,541	569
4,829	536
4,784	171
4,900	103
5,499	82
5,812	64
4,121	44
5,813	42
4,111	41
7,538	36