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# Risk Assessment for ATM Using Algebra of Logics

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***Abstract – An automated teller machine (ATM) is a computerized tele-communications device that provides the customers of a financial institution with access to financial transactions in a public space without the need for a human clerk or bank teller. On most modern ATMs, the customer is identified by inserting a plastic ATM card with a magnetic stripe or a plastic smart card with a chip that contains a unique card number and some security information, such as an expiration date or CVC (CVV). Security is provided by the customer entering a personal identification number (PIN). They are sometimes referred to as "ATM machines", an example of RAS syndrome. Using an ATM, customers can access their bank accounts in order to make cash withdrawals and check their account balances.***

***Key Words : Tele-Communications, ATM, CVC***

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## INTRODUCTION

An automated teller machine (ATM) is a computerized tele-communications device that provides the customers of a financial institution with access to financial transactions in a public space without the need for a human clerk or bank teller. On most modern ATMs, the customer is identified by inserting a plastic ATM card with a magnetic stripe or a plastic smart card with a chip that contains a unique card number and some security information, such as an expiration date or CVC (CVV). Security is provided by the customer entering a personal identification number (PIN). They are sometimes referred to as "ATM machines", an example of RAS syndrome. Fig-1(a) shows an ATM mouth.

***Fig-1(a): Shows ATM mouth***

Using an ATM, customers can access their bank accounts in order to make cash withdrawals (or credit card cash advances) and check their account balances.

British Actor Reg Varney: Use the world's first ATM in 1967 located at a branch of Barclays Bank, Enfield. The system was developed by De La Rue.

The first mechanical cash dispenser was developed and built by Luther George Simjian, installed in 1939 in New York city by the Bank of New York, but removed after 6 months due to the lack of customer acceptance.

Thereafter, the history of ATMs paused for over 25 years, until De La Rue developed the first electronic ATM, which was installed first in Enfield town in North London United Kingdome on 27$^{th}$ June 1967 by Barclays Bank. This instance of invention is credited to John Shepherd Barron although various other engineers were awarded patents for related technologies at the time. Shepherd Barron was awarded an OBE in the 2005 New York's Honors list.

The first person to use the machine was the British variety artist and actor Reg Vauney. The first ATMs accepted only a single use token or voucher which was retained by the machine. These worked on various principles including radiation and low coercivity magnetism that was wiped by the card reader to make fraud more difficult. The machine dispensed pre-packaged envelopes containing ten Ponds sterling. The idea of a PIN stored on the card was developed by the British engineer James Good Fellow in 1965. Fig-1(b) represents an ATM station with two parallel machines

In this chapter, the author has done his analysis to compute the capability of a ATM system. In this study, the author assumes two ATMs which are connected in parallel. The capability of the system is affected by all the units of the system. Block diagram of considered system.

The author has been used two standby redundant bank computers to improve system's overall performance. This standby unit can be online through an imperfect switching device.

Using algebra of logics the author has done mathematical formulation of the system. This mathematical model has been solved by employing Boolean function technique. Reliability of considered system has been computed.

Reliability functions have been obtained in two different cases, when failures follow weibull and exponential time distributions.

An important reliability parameter, viz. mean time to failure of considered system has also been computed to improve practical utility of the model. Graphical illustration followed by a numerical computation has been appended at the end to highlight important results of the study.

***Fig-1(b): Represents an ATM station with two parallel machines***

## FORMULATION OF MATHEMATICAL MODAL

Conditions of capability for successful operation of considered system, in terms of logical matrix, can be expressed as given below:

$$F(x_1, x_2 --x_7) = \begin{bmatrix} x_1 & x_2 & x_4 & x_5 & \\ x_1 & x_2 & x_4 & x_6 & x_7 \\ x_1 & x_3 & x_4 & x_5 & \\ x_1 & x_3 & x_4 & x_6 & x_7 \end{bmatrix} \quad \ldots(1)$$

## SOLUTION OF THE MODEL

By using algebra of logics, equation (1) may be written as:

$$F(x_1, x_2 ---x_7) = [x_1 \;\; x_4 \;\; \wedge A] \quad \ldots(2)$$

where,

$$A = \begin{bmatrix} x_2 & x_5 & \\ x_2 & x_6 & x_7 \\ x_3 & x_5 & \\ x_3 & x_6 & x_7 \end{bmatrix} \quad \ldots(3)$$

Substituting the following into equation (3),

$$P_1 = [x_2 \quad x_5]$$

$$P_2 = [x_2 \quad x_6 \quad x_7]$$

$$P_3 = [x_3 \quad x_5]$$

$$P_4 = [x_3 \quad x_6 \quad x_7]$$

We obtain

$$A = \begin{bmatrix} P_1 \\ P_2 \\ P_3 \\ P_4 \end{bmatrix}$$

Using orthogonalization algorithm, we get

$$A = \begin{bmatrix} P_1 & & & \\ P_1' & P_2 & & \\ P_1' & P_2' & P_3 & \\ P_1' & P_2' & P_3' & P_4 \end{bmatrix} \quad \ldots(4)$$

Now using algebra of logics, we have

$$P_1 = [x_2 \quad x_5]$$

$$\therefore P_1' = \begin{bmatrix} x_2' & \\ x_2 & x_5' \end{bmatrix}$$

$$\therefore P_1'P_2 = \begin{bmatrix} x_2' & \\ x_2 & x_5' \end{bmatrix} \wedge [x_2 \quad x_6 \quad x_7]$$

$$= [x_2 \quad x_5' \quad x_6 \quad x_7] \quad \ldots(5)$$

Similarly, we obtain

$$P_1' P_2' P_3 = [x_2' \quad x_3 \quad x_5] \qquad \ldots(6)$$

and

$$P_1' P_2' P_3' P_4 = [x_2' \quad x_2 \quad x_5' \quad x_6 \quad x_7] \qquad \ldots(7)$$

Using equations (5) to (7), equation (4) becomes

$$A = \begin{bmatrix} x_2 & x_5 & & & \\ x_2 & x_5' & x_6 & x_7 & \\ x_2' & x_3 & x_5 & & \\ x_2' & x_3 & x_5' & x_6 & x_7 \end{bmatrix} \qquad \ldots(8)$$

Using equation (8) into equation (2), we obtain

$$F(x_1, x_2 --x_7) = \begin{bmatrix} x_1 & x_2 & x_4 & x_5 & & & \\ x_1 & x_2 & x_4 & x_5' & x_6 & x_7 & \\ x_1 & x_2' & x_3 & x_4 & x_5 & & \\ x_1 & x_2' & x_3 & x_4 & x_5' & x_6 & x_7 \end{bmatrix} \qquad \ldots(9)$$

Since R.H.S. of equation (9) is disjunction of pair-wise disjoint conjunctions, therefore, reliability of considered A.T.M. system is given by:

$$R_S = \Pr\{F(x_1, x_2 --- x_7) = 1\}$$

$$= R_1 R_4 [R_2 R_5 + S_5 R_2 R_6 R_7 + S_2 R_3 R_5 + S_2 S_5 R_3 R_6 R_7]$$

where $S_i = 1 - R_i \qquad \forall\, i = 1,2----7.$

Thus,

$$R_S = R_1 R_4 [R_2 R_5 + R_2 R_6 R_7 + R_3 R_5 + R_3 R_6 R_7 + R_2 R_3 R_5 R_6 R_7$$

$$- R_2 R_5 R_6 R_7 - R_2 R_3 R_5 - R_2 R_3 R_6 R_7 - R_3 R_5 R_6 R_7] \qquad \ldots(10)$$

## RESULTS AND DISCUSSION

Analysis of fig-1(a) reveals that reliability function $R_{SW}(t)$ decreases catastrophically in the beginning but thereafter it decreases constantly. The value of $R_{SE}(t)$ remains better as compared of $R_{SW}(t)$. A critical examination yields that the value of MTTF(E) decreases rapidly as we make increase in the values of failure rate λ but thereafter it decreases in a constant manner. The value of MTTF(E) remains better as compared of MTTF(W).

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