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Examination Malpractices Detection Using Random Matrix Algorithms

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Abstract:
Examination fraud detection is an important research area in e-testing. Fraud detection and prevention ensure that the outcome of an examination being academic or professional meets actual capabilities of the candidates. Instead of depending on human efforts to monitor a real-life examination, computational techniques could be deployed to ensure a more effective invigilation process. Many cases of cheating in examinations involve the collusion of two or more individuals, especially based on the level of familiarity that may have existed before the examination. Hence an effective control system should strongly incorporate anti-collusion measures. The major contribution of the Matrix-Based Fraud Check technique is the application of using randomized algorithms to prevent examination fraud. This can be achieved by breaking the pre-examination social links that could lead to examination collusions. This model could analyze the existing seating arrangements and as well suggests the most optimal arrangement that reduces collusion to the barest minimum. The model also generates a watch list of candidates that are most likely to collude in a particular examination hall. This vital information will no doubt guide the examiners in the investigation process.
Keywords: Fraud Detection, Random Algorithms, Matrix-Based, Watch List

I. Introduction

The Examination Fraud Detection Algorithm (EFDA) is a computational technique that could be applied in a class-room setting to prevent examination cheat/ fraud or malpractise[1,4]. The EFDA algorithm was partly presented as Fraud Detection Using Random Forest Algorithm[2]. The aim of presenting this work in a peer-reviewed international journal was to capture the critical feedbacks and contributions of the research community on frauds being perpetrated by the use of the internet with the view to improve its efficiency using Random Forest Algorithm. This paper therefore focuses on matrix-based fraud detection algorithm. This research work could take on an examination hall size of up to 81 candidates, equivalent to a data dimension of 9 rows by 9 columns, rather than some of the previous works that accommodate less. The Computational Models for Examination Fraud Control Using Randomized Algorithms[3] which shows that the Matrix-Based Fraud Detection (MFD) Algorithm computes a set of integer values known as *Familiarity Index* used to determine the level of familiarity between individual human beings/ seats in the examination hall, and also applied in the overall fraud detection algorithm[6].

II. The Algorithm

The proposed Matrix-Based Fraud Detection (MFD) Algorithm, attempts to break the possible effects established social contacts or familiarity in the examination hall[5,7,8]. Previous research, points to the fact that widespread examination fraud could be perpetrated based on departmental or faulty sitting arrangement in the examination hall. For instance, a related research[7] reported that 66% of the frauds observed in a particular undergraduate examination came in two categories - 19% were due to collusion between students, while 47% were due to spying of other students' examination scripts[8]. One of the assumptions of the current research is that when two or more persons have pre-examination seating [9,11,12], they could take advantage of their pre-knowledge of each other's academic capabilities to collude with themselves in the examination hall. This is particularly possible if they usually sit close to themselves in the class-room before the exams, and were also allowed to sit close to themselves during the exams. In order to control examination fraud, a computerized algorithm is hereby applied to change the original sitting arrangement of candidates[12]. The randomized algorithm[10] that takes the digitized format of the pre-examination seating arrangement as input, in order to derive the randomized format as presented in "A New Randomness Test for Bit Sequences".

Details of Algorithm

The MFD algorithm makes use of an original seating arrangement, which is approximated to a two dimensional rectangular or square room. In electronic terms, the 'original seats' are the elements of a matrix, representing a hypothetical class room in Table 1. The table element C_{xy} for instance, represents a person sitting in row x, column y in the seating matrix. As earlier mentioned, one of the keys aims of the MFD algorithm is to breach the familiarity existing between candidates in the examination hall. This is based on the assumption that, the more the familiarity between two persons, the greater the possibility of collusion. Breaching the familiarity[9] is achieved by introducing a measure of randomnes[10]. A computational procedure is also used in this research to estimate the familiarity between any two persons, based on the seating arrangement[11]. The familiarity index between two candidates is defined as the measure of the absolute value (ABS) of the difference between their corresponding indices in the seating matrix. Thus, in mathematical terms, the measure of the familiarity between the candidates C_{wx} and C_{yz} is given by equation (1).

$FamiliarityIndex(C_{wx},C_{yz})$=ABS$(wx-yz)$ ……………………… (1)

where, w and x are the rows and columns of the first candidate, y and z are the rows and columns of second candidate, while wx and yz are the indices of the seating[12,13].

Example, for the seating positions $C_{wx}= C_{23}$, and $C_{yz}= C_{36}$, the *FamiliarityIndex* (C_{23}, C_{36}) = *ABS* (23-36), which is 13. Two persons are said to be very close, if their *familiarity index* is in the set {1,9,10,11}. This occurs when a particular candidate 'XYZ' in an examination is sitting adjacent to any of the eight positions marked '*' in Fig. 1. Thus, the seating positions adjacent to the right, left, front, back or diagonal positions of 'XYZ', will lead to such *familiarity indices*. Some examples of such positions as can be extracted from Table 1 are {C22, C23}, {C34, C43}, {C55, C45}, {C52, C63,}and so on.

Table 1: A Hypothetical Class Room

C11	C12	C13	C14	C15
C21	C22	C23	C24	C25
C31	C32	C33	C34	C35
C41	C42	C43	C44	C45
C51	C52	C53	C54	C55
C61	C62	C63	C64	C65

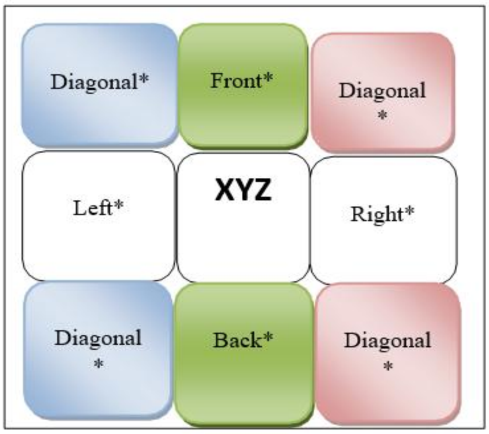

Fig 1: Adjacency Positions

Thus, the MFD algorithm strives to computationally re- arrange the original seating positions, so as to avoid occurrences of familiarity indices '1', '9', '10' and '11'.

System Implementation and Output

The MFD algorithm was implemented in MATLAB Version 7.8.0.347 (R2009a), and tested using a classroom size of 40 candidates. The input dataset is a two-dimensional 5 x 8 array of seating arrangement[10].In the source code, this original seating matrix is denoted by 'OrigSeatMatrix'. The resulting output, which is a randomized seating arrangement, is another 5 x 8 array called 'RandSeatMatrix'. The exact input dataset is shown in Table 2.

Table 2: Dataset for Seating Arrangement Runs

11	12	13	14	15	16	17	18
21	22	23	24	25	26	27	28
31	32	33	34	35	36	37	38
41	42	43	44	45	46	47	48
51	52	53	54	55	56	57	58

The flowchart[14]used for the system implementation is shown in Fig. 2, while the corresponding source code is shown in the appendix A. The output of the MFP algorithm is shown in Fig. 3.

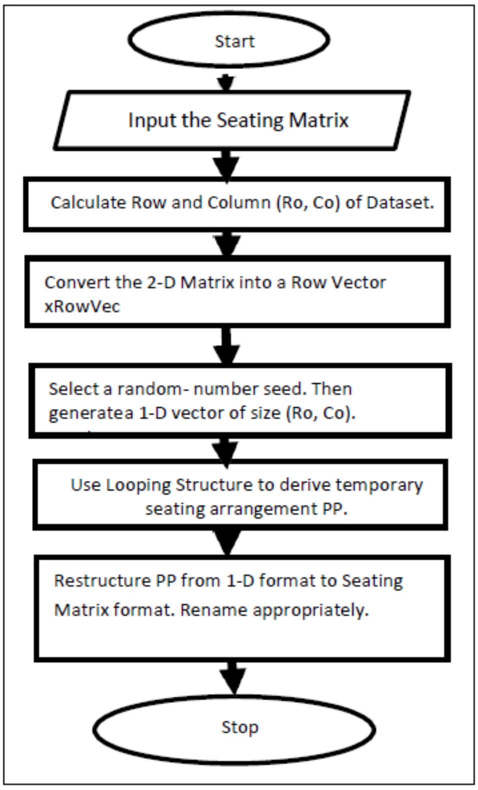

Fig 2: Flowchart for MFP Algorithm

III. System Validation

A validation program[15] was developed as part of the postMFD model runs. The aim of this is to scan through the resultoftherandomizationoperation,anddetectisolatedcaseswherethefamiliarityindicesof1,9,10and11remainedunchanged. Such isolated cases form what is termed the *watchlist*[14,15] of candidates, for closer attention by the invigilators.The source code for the watch list is called watchProgram.m,and is listed in Appendix A of this research paper. ComparingthefinaloutputinFig3withthewatchlistevolution procedure as explained using Fig 1, it follows that the resulting watch list consists of the five pairs of candidates: {32, 31}, {17,16}, {53,52}, {26,27} and {23,12}. Thus, these isolated positionsare either are either changed manually, or left as a watchList for the invigilators.

IV. Conclusion

With the generation of a newrandomized seating arrangement, the computational objectives of MFD algorithm are assumed to be realized with precise and minimalnumber of items in the watch list.Future focus could be extended to integration of artificialintelligenceintotheprocessasameansofdetecting examination frauds.

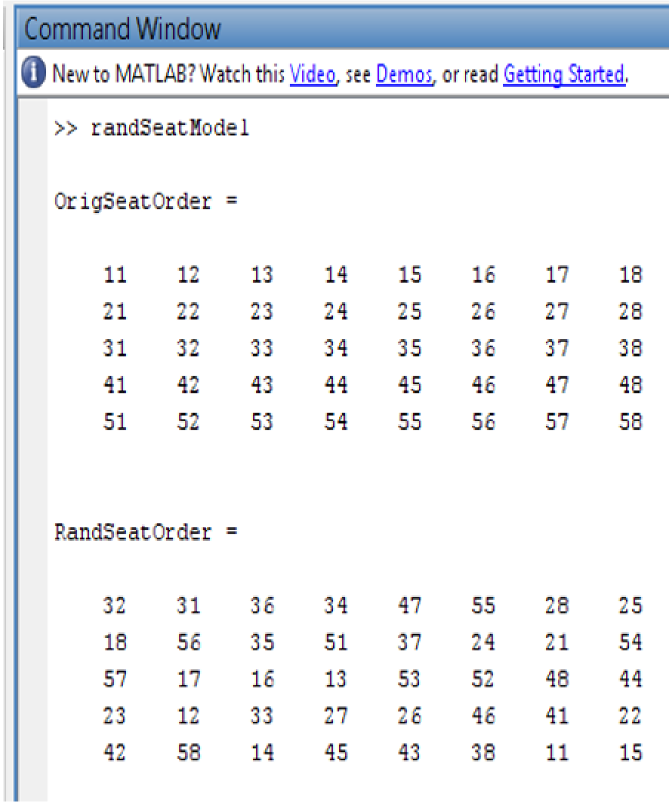

Fig.3: Output of MFP Model Runs

Appendix A:

```
%************SOURCE CODE ******************
% Aim of Program: Examination Fraud Detection Model
% Prog. Lang:     MATLAB
% Module Name:RSeatArr.m
%DataSet:         The Matrix of Original Seating
%          Arrangement
%************************** ******************

% Bring in the DataSet
OrigSeatMatrix= [11 12 13 14 15 16 17 18;

21 22 23 24 25 26 27 28;
31 32 33 34 35 36 37 38;
41 42 43 44 45 46 47 48;
51 52 53 54 55 56 57 58]

%Take note of the rows and columns. [numrow,numcol]=size(OrigSeatMatrix);

%The 2-dimentional array is first converted to a row vector. xrovec=
reshape(OrigSeatMatrix',numrow*numcol,1)';

%Randomize the Row Vector:
rand(1000);
rpam= randperm(numrow*numcol);

%Generate the new Matrix gg in Randomized Format.
% The rpam positions will be used to randomize gg thru the index
for k=1:numrow*numcol
gg (rpam(k)) =xrovec (k); end
```

```
%Reshape back into a 3 by 4 matrix RandSeatMatrix=reshape(pp,numrow,numcol)

%************SOURCE CODE ******************
% Aim of Program: Used to generate an isolated list
%         of Candidates in the Watch List for
%         invigilators attention.
% Prog. Lang:     MATLAB
% Module Name: watchProgram.m
%DataSet:         Output of the model run as
%         described in the paper.
%************************** ******************

% Assign the variable name 'a' to the RandSeatMatrix. a=RandSeatMatrix
for m=1:5
for wk=1:8 if (wk< 8)
x =abs(a(m,wk) - a(m,wk+1)); if (x==1)
m;
wk;
a (m,wk)
a(m,wk+1) end

end

end

end
for m=1:5

for wk=1:8 if (wk< 8)
x =abs(a(m,wk) - a(m,wk+1)); if (x==10)
m;
wk;
a (m,wk)
a(m,wk+1) end

end end

for m=1:5
for wk=1:8 if (w < 8)
x =abs(a(m,wk) - a(m,wk+1)); if (x==11)
m;
wk;
a (m,wk)
a(m,wk+1) end

end end
end
```

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