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STATISTICAL QUALITY IN-CONTROL/OUT-OF-CONTROL FORECASTING USING SCORES AND UPCROSSINGS

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ABSTRACT

A case study in Statistical Quality Control highlights the relevance of sensitivity, specificity, positive predictive value, and negative predictive value for In-Control/Out-of-Control diagnosis. Suspicious data probability patterns are computed and assessed through confusion matrices and (mis)classification performance metrics, showing how pattern contributions influence average false discoveries and false omissions. These findings support the effectiveness of the monitoring strategy in balancing the risks of unnecessary process interruptions against overlooked anomalies. Daily scoring and 15-period moving averages are also examined, establishing the prognostic value of 0-upcrossings in moving averages as reliable indicators of impending process halts.

Keywords: Statistical Quality Control; Performance Metrics; Confusion Matrix; Scores; Moving Averages

1 INTRODUCTION

Statistical Quality Control is essential for Total Control Management, with the goal of Lean Management inspired in Toyota's production system; it is essential for consumer's confidence, and in many areas required in the labelling of products, namely in food industries. On the other hand, it is of the utmost importance for competitiveness and leadership of enterprises.

In the present potato chip factory case study, stabilizing oil temperature in the frying unit is a critical requirement for ensuring consistent product quality. Excessive temperatures can lead to starch burning, while insufficient heating compromises de-oiling, seasoning and crispness.

In September 2024, a new frying line was installed in the factory and based on the supplier's recommendation, the target operating temperature was established at 180 °C ± 4 °C. The quality control team accordingly classified temperatures within the range [175 °C, 185 °C] as Negative (N), corresponding to In-Control (InC) operation, and values outside this range as Positive (P), interpreted as potential Out-of-Control (OutC) conditions. During the three-month period from October to December 2024, the team continued to apply the same monitoring and feedback procedures used with the previous equipment. However, under these procedures, production was halted for maintenance on 37 occasions in this period, as summarized in Table 1.

Table 1: Production halts and downtimes

Date	Start-end time	Total downtime	Date	Start-end time	Total downtime
Oct. 07	14:08-14:37	00:29	Nov. 19	11:18-11:20	00:02
Oct. 10	22:26-22:48	00:22	Nov. 19	11:28-11:30	00:02
Oct. 15	11:24-13:37	01:49	Nov. 19	13:16-13:42	00:26
Oct. 16	17:04-17:10	00:06	Nov. 19	19:14-19:16	00:02
Oct. 21	14:20-14:44	00:24	Nov. 19	19:32-19:36	00:04
Oct. 23	09:16-09:18	00:02	Nov. 19	20:18-20:24	00:06
Oct. 23	10:04-10:35	00:31	Nov. 22	14:22-14:51	00:29
Oct. 25	15:08-15:54	00:46	Nov. 29	16:18-16:20	00:02
Oct. 28	19:26-19:28	00:02	Nov. 29	18:18-18:58	00:40
Oct. 28	20:16-20:39	00:13	Dec. 04	10:12-10:19	00:07
Oct. 30	09:54-09:56	00:02	Dec. 05	17:14-17:28	00:14
Oct. 30	10:14-10:16	00:02	Dec. 10	11:02-11:35	00:33
Oct. 30	10:20-10:22	00:02	Dec. 11	09:14-09:20	00:06
Oct. 30	12:40-12:47	00:07	Dec. 11	10:30-10:32	00:02
Oct. 30	15:12-15:14	00:02	Dec. 11	13:12-13:42	00:30
Nov. 04	08:24-08:29	00:05	Dec. 12	12:06-12:12	00:06
Nov. 05	11:20-11:45	00:25	Dec. 13	12:04-12:30	00:26
Nov. 08	16:02-16:39	00:37	Dec. 16	16:14-16:33	00:19
Nov. 13	08:44-09:28	00:44			

Over the 69 working days observed, total production downtime amounted to 11.1 hours out of 1,380 production hours. This yields an estimated probability of OutC operation of $\pi_1=11.1/1380\approx0.008$, and a probability of InC operation of $\pi_0 = 1 - \pi_1 \approx 0.992$. Although consistent with expectations for new equipment, these estimates provide no timely indication of potential shifts from InC to OutC, nor do they clarify whether alarms correspond to False Discoveries or whether missed alarms imply False Omissions, both of which carry distinct production risks and monetary losses. For this reason, an external multidisciplinary team was convened to analyze the data, evaluate the strengths and limitations of the statistical quality control benchmark, and recommend modifications to enhance forecasting. The main findings, updated feedback and control procedures, the design of scoring methods, and the application of moving averages are useful guidelines to anticipate OutC surges.

Pestana and Brilhante [1] developed an insightful InC/OutC shift forecasting treating the daily set of 600 two minutes temperature readings as a digital ant colony, producing digital pheromones. The present report, complementing studies on InC/OutC forecasting using scores to aggregate information [1–3], is organized as follows:

Section 2 describes the collection of frying unit temperature data and their classification into True Positives (TP), False Positives (FP), True Negatives (TN), and False Negatives (FN) by the factory Quality Control team; the code used to generate color coding is provided in Appendix A. The PPP termination codon 8-ary temperature sequences were flagged as suspicious, and the use of mismatching metrics derived from the corresponding confusion matrices to estimate the contribution of these sequences is discussed.

Section 3 addresses the four possible suspicious patterns in which all temperature readings preceding the terminating codon were negative and quantifies the contribution of each pattern to expected losses. Similar calculations were performed for all suspicious sequences of temperature readings over two-minute periods that meet the criteria outlined in Section 2.

Section 4 describes nine suspicious patterns containing one P before the terminating PPP codon, along with the corresponding confusion matrices and contributions to expected losses. Detailed examination of pattern probabilities under InC and OutC conditions is provided in Appendix B.

Section 5 addresses sixteen suspicious patterns with two Ps preceding the terminating PPP codon, including confusion matrices, contributions to expected losses, and detailed probability calculations in Appendix C.

Section 6 covers twelve suspicious patterns with three Ps before the terminating PPP codon, along with confusion matrices, contributions to expected losses, and detailed examinations in Appendix D.

By themselves, isolated deviations from the temperature target are mostly noise; only the accumulation of evidence in clusters of sequences flagged as suspicious can be considered a signal that maintenance or repair is required. Section 7 briefly discusses the use of scores and their moving averages for diagnosing clustering of suspicious sequences that signal shifts from InC to OutC. The section further discusses the likelihood of a shift toward OutC when clustering of suspicious sequences produces positive moving average scores.

2 FACTORY QUALITY CONTROL ROUTINES

Oil temperature was recorded every 15 seconds, and since each frying batch has a standard duration of 2 minutes, 8-ary sequences of consecutive temperature readings were continuously monitored. Sequences terminating with a PPP codon were flagged as suspicious. By providing the classification algorithm with appropriate instructions (see Appendix A), the temperature readings were then recoded into True Positives (TP), False Positives (FP), False Negatives (FN) and True Negatives (TN) as follows:

- TN if $\begin{cases} t \in [176°, 184°], \text{ or} \\ t \in (184°, 185°] \text{ and the subsequent value is } < 185°, \text{ or} \\ t \in [175°, 176°) \text{ and the subsequent value is } > 175° \end{cases}$;

- FN if $\begin{cases} t \in (184°, 185°] \text{ and the subsequent value is } \geq 185°, \text{ or} \\ t \in [175°, 176°) \text{ and the subsequent value is } \leq 175° \end{cases}$;

- TP if $\begin{cases} t \geq 188°, \text{ or} \\ t \in (185°, 188°) \text{ and the subsequent value is } > 185°, \text{ or} \\ t \leq 172°, \text{ or} \\ t \in (172°, 175°) \text{ and the subsequent value is } < 175° \end{cases}$;

- FP if $\begin{cases} t \in (185°, 188°) \text{ and the subsequent value is } \leq 185°, \text{ or} \\ t \in (172°, 175°) \text{ and the subsequent value is } \geq 175° \end{cases}$.

The original ratio-scale temperature data (Stevens [4]) were recoded into a nominal scale for rapid visual inspection, using the categories:

- True Negatives (TN, green dot ●)
- False Negatives (FN, blue dot ●)
- False Positives (FP, yellow dot ●)
- True Positives (TP, red dot ●)

(An 8-ary temperature sequence would appear as ● ● ● ● ● ● ● ●.)

To address potential confounding, FP and FN were specifically highlighted using yellow and blue dots, respectively. The recoding code is retrieved in Appendix A.

Obviously, downgrading from the ratio scale to a nominal scale loses information, but this decision of the factory Quality Control team resulted from recognition of poor ability to timely interpret numerical data, while color visualization was immediate. On the other hand, the team leader claimed that this had been inspired in Kanban Lean Methods [5] visual system to manage workflow and Just-in-Time manufacturing intervention strategies.

Focusing on rising temperatures, the classification rules were:

- $t \in (176^\circ, 184^\circ] \rightarrow$ TN (green dot ●);
- No three consecutive readings $> 185^\circ$ among t_1, t_2, t_3, t_4;
- $t_5 \in (175^\circ, 185^\circ] \rightarrow$ N (green dot ● or blue dot ●);
- $t_6, t_7, t_8 \in (185^\circ, 188^\circ] \rightarrow$ P (red dot ● or yellow dot ●);
- $t > 188^\circ \rightarrow$ TP (red dot ●).

These classifications were used to construct confusion matrices and compute standard performance metrics, including sensitivity (TPR), specificity (TNR), positive predictive value (PPV), false discovery rate (FDR), negative predictive value (NPV), and false omission rate (FOR). The (mis)matching metrics are described in Table 2, and Table 3 exhibits the usual presentation of the performance matrix. For detailed discussions, see [6–14].

Table 2: Classification metrics

Metric	**Abbreviation and definition**
Sensitivity or True Positive Rate	TPR = TP / P
Specificity or True Negative Rate	TNR = TN / N
False Negative Rate	FNR = FN / P
False Positive Rate	FPR = FP / N
Prevalence	Prev = P / (P + N)
Positive Predictive Value (precision)	PPV = TP / (TP + FP)
Negative Predictive Value	NPV = TN / (TN + FN)
False Discovery Rate	FDR = FP / (TP + FP)
False Omission Rate	FOR = FN / (TN + FN)
Positive Likelihood Rate	LR^+ = TPR / FPR
Negative Likelihood Rate	LR^- = FNR / TNR
Accuracy	Acc = (TP + TN) / (P + N)
Balanced Accuracy	BAcc = (TPR + TNR) / 2
Bookmaker Informedness	BM = TPR + TNR - 1
Markedness	MK Δ_P = PPV + NPV - 1

Prevalence Threshold	PT = (√(TPR × FPR) - FPR) / (TPR - FPR)
Diagnosis Odds Ratio	DOR = LR^+ / LR^-
F_1 score	F_1 score = (2 × PPV × TPR) / (PPV + TPR) = 2TP / (2TP + FP + FN)
Fowlkes–Mallows Index	FM = √(PPV × TPR)
Critical Success Index (CSI) or Jaccard Index (JI)	CSI = TP / (TP + FN + FP)
Mathews Correlation Coefficient	MCC = √(TPR × TNR × PPV × NPV) - √(FNR × FPR × FOR × FDR)

Table 3: Performance metrics matrix

Total	**DOutC**	**DInC**	**BM**	**PT**
OutC (P)	TP	FN	TPR	FNR
InC (N)	FP	TN	FPR	TNR
Prev	PPV	NPV	LR+	LR-
Acc	FDR	FOR	MK ΔP	DOR
BAcc	F1 score	FM index	MCC	CSI

Using the criterion that three consecutive P observations — either greater than 185° or smaller than 175° — are considered suspicious, color-coded charts of the eight temperature readings collected over a two-minute frying period can be generated, as illustrated in Figure 1.

The corresponding confusion and (mis)matching metrics matrix is presented in Table 4.

The 8-ary sequence ●●●●●●●●●, shown in Figure 1, has a probability of p_0 =7.39×10^{-6} under InC conditions and p_1 = 1.53×10^{-4} under OutC conditions. With a positive predictive value (PPV)

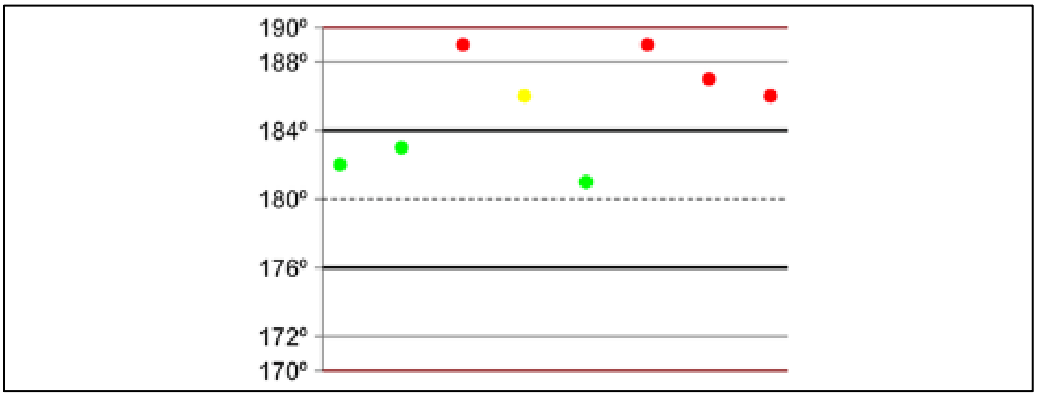

Figure 1: A two-minute temperature 8-ary sequence ending with a PPP codon.

Table 4: Confusion matrix/(mis)matching metrics

Total=8	**DInC**	**DOutC**	**BM=0.8**	**PT =0.3333**
OutC (P)=5	TP=4	FN=0	TPR=0.8	FNR=0.2
InC (N)=3	FP=1	TN=3	FPR=0	TNR= 1
Prev= 0.625	PPV=0.8	NPV=1	LR^+ = —	LR^-= 0.2
Acc=0.875	FDR=0.2	FOR=0	MK ΔP =0.8	DOR = —
BAcc= 0.9	F_1 score=0.8	FM index = 0.8	MCC= 0.8	CSI= 0.8

of 0.8 and a false discovery rate (FDR) of 0.2, and assuming a loss of €3,560 for unnecessarily stopping the line, this pattern contributes approximately €0.00526 to expected losses. Conversely, if failing to stop the line under OutC conditions incurs a loss of €5,870, the expected contribution to false omission loss is €0.

Analogous computations were carried out for all sequences over the two-minute frying period that meet specific criteria — specifically, sequences ending with ●●● or ●●● (Sections 3-6). These analyses complement Pestana and Brilhante [3], providing detailed evidence to support updates to feedback and control rules and to highlight strengths and limitations of the existing quality control routines.

3 SUSPECT 8-ARY CODES WITH NO P IN THE INITIAL SUBSEQUENCE OF CODES

Table 5 displays patterns and probabilities when there are no P observations the initial 5 codes in the 8-ary suspect sequences.

Tables 6-9 present the corresponding confusion matrices along with the associated classification metrics. The expected contribution to losses from false discoveries is €0.04454, while the contribution from false omissions is €0.00006.

Table 5: Patterns with no Ps in the initial section

TN	TN	TN	TN	N	TP	TP	P	p | H_0	p | H_1	TP	FP	FN	TN
●	●	●	●	●	●	●	●	0.00013669	6.6579×10^{-6}	3	0	0	5
●	●	●	●	●	●	●	●	0.00000861	7.8530×10^{-7}	3	0	1	4
●	●	●	●	●	●	●	●	0.00049808	6.6579×10^{-6}	2	1	0	5
●	●	●	●	●	●	●	●	0.00003138	7.8530×10^{-7}	2	1	1	4
								0.00067476	1.48864×10^{-5}				

$\mathbf{p_0 / p_1 \approx 5621}$

Table 6: Confusion matrix for the pattern TN, TN, TN, TN, TN, TP, TP, TP

T = 8	**DOutC**	**DInC**	**BM = 1**	**PT = 0**
P = 3	TP = 3	FN = 0	TPR = 1	FNR = 0
N = 5	FP = 0	TN = 5	FPR = 0	TNR = 1
Prev = 0.375	PPV = 1	NPV = 1	LR^+ = —	LR^- = 0
Acc = 1	FDR = 0	FOR = 0	MK = 1	DOR = —
BAcc = 1	F_1 score = 1	FM index = 1	MCC = 1	CSI = 1

$p_0 = 1.3559 \times 10^{-4}$; $p_1 = 5.32632 \times 10^{-8}$;Contribution to expected losses from false discoveries = 0; Contribution to expected losses from false omissions = 0

Table 7: Confusion matrix for the pattern TN, TN, TN, TN, FN, TP, TP, TP

T=8	**DOutC**	**DInC**	**BM=0.8**	**PT=0.309**
P=3	TP=3	FN=0	TPR=1	FNR=0
N=5	FP=1	TN=4	FPR=0.2	TNR=0.8
Prev=0.375	PPV=0.75	NPV=1	LR^+=5	LR^-=0
Acc=0.875	FDR=0.25	FOR=0	MK=0.75	DOR=—
BAcc=0.9	F_1 score=0.857	FM index=0.866	MCC=0.775	CSI=0.75

$p_0 = 8.5411 \times 10^{-6}$; $p_1 = 6.28240 \times 10^{-9}$.; Contribution to expected losses from false discoveries = 0.00760.; Contribution to expected losses from false omissions = 0.

Table 8: Confusion matrix for the pattern TN,TN,TN,TN,TN,TP,TP,FP

T=8	**DOutC**	**DInC**	**BM=0.667**	**PT=0**
P=3	TP=2	FN=1	TPR=0.667	FNR=0.333
N=5	FP=0	TN=5	FPR=0	TNR=1
Prev=0.375	PPV=1	NPV=0.833	LR^+ = —	LR^- = 0.333
Acc=0.875	FDR=0	FOR=0.167	MK=0.833	DOR = —
BAcc=0.833	F_1 score = 0.8	FM index = 0.816	MCC = 0.745	CSI = 0.667

$p_0 = 4.9409 \times 10^{-4}$; $p_1 = 5.32632 \times 10^{-8}$; Contribution to expected losses from false discoveries = 0.; Contribution to expected losses from false omissions = 0.00005.

Table 9: Confusion matrix for the pattern TN,TN,TN,TN,FN,TP,TP,FP

T=8	DOutC	DInC	BM=0.467	PT=0.359
P=3	TP=2	FN=1	TPR=0.667	FNR=0.333
N=5	FP=1	TN=4	FPR=0.2	TNR=0.8
Prev=0.375	PPV=0.667	NPV=0.8	LR^+=3.333	LR^-=0.417
Acc=0.75	FDR=0.333	FOR=0.2	MK=0.467	DOR=8
BAcc=0.733	F_1 score=0.667	FM index=0.667	MCC=0.467	CSI=0.5

$p_0 = 3.1129 \times 10^{-5}$; $p_1 = 6.28240 \times 10^{-9}$; Contribution to expected losses from false discoveries = 0.03694.; Contribution to expected losses from false omissions = 0.00001.

4 SUSPECT 8-ARY CODES WITH ONE P (EITHER TP OR FP) AMONG THE INITIAL FOUR CODES

From Tables 51-54 in Appendix B, we conclude that when a single P occurs among the first four observations of the initial section, there are nine possible combinations of (TP, FP, FN, and TN), as summarized in Table 10.

Table 10: Patterns when there exists one P in the first four positions

TP	**FP**	**FN**	**TN**	**Number of Cases**	$\mathbf{p \mid H_0}$	$\mathbf{p \mid H_1}$
4	0	0	4	4	0.00001329	0.00011290
4	0	1	3	7	0.00000146	0.00010862
4	0	2	2	3	0.00000004	0.00002499
3	1	0	4	8	0.00009685	0.00014603
3	1	1	3	14	0.00001061	0.00014049
3	1	2	2	6	0.00000028	0.00003232
2	2	0	4	4	0.00017646	0.00003313
2	2	1	3	7	0.00001933	0.00003187
2	2	2	2	3	0.00000052	0.00000733
				Total	0.000318837	0.000637673

$$\mathbf{p_0 / p_1 \approx 62}$$

The confusion matrices and classification metrics for the nine possible (TP, FP, FN, TN) patterns (Tables 11–19, summarized in Table 10) indicate expected contributions to losses of €0.03478 from false discoveries and €0.60200 from false omissions, based on the pattern probabilities and the corresponding FDR and FOR values.

Table 11: Confusion matrix for (TP,FN,FP,TN)=(4,0,0,4)

T=8	**DOutC**	**DInC**	**BM=1**	**PT=0**
P=4	TP=4	FN=0	TPR=1	FNR=0
N=4	FP=0	TN=4	FPR=0	TNR=1
Prev=0.5	PPV=1	NPV=1	LR^{+} —	LR^{-}=0
Acc=1	FDR=0	FOR=0	MK=1	DOR —
BalAcc=1	F_1 score=1	FMI=1	MCC=1	TS score=1

$p_0 = 1.31837 \times 10^{-5}$; $p_1 = 9.032 \times 10^{-7}$.; Contribution to expected losses from false discoveries = 0.; Contribution to expected losses from false omissions = 0.

Table 12: Confusion matrix for (TP,FN,FP,TN)=(4,0,1,3)

T = 8	**DOutC**	**DInC**	**BM = 0.75**	**PT = 0.3333**
P = 4	TP = 4	FN = 0	TPR = 1	FNR = 0
N = 4	FP = 1	TN = 3	FPR = 0.25	TNR = 0.75
Prev = 0.5	PPV = 0.8	NPV = 1	LR^{+} = 4	LR^{-} = 0
Acc = 0.875	FDR = 0.2	FOR = 0	MK = 0.8	DOR = —
BalAcc = 0.875	F_1 score = 0.8889	FMI = 0.8944	MCC = 0.7746	TS score = 0.8

$p_0 = 1.44832 \times 10^{-6}$; $p_1 = 8.6896 \times 10^{-7}$; Contribution to expected losses from false discoveries = 0.001031204; Contribution to expected losses from false omissions = 0

Table 13: Confusion matrix for (TP,FN,FP,TN)=(4,0,2,2)

T=8	**DOutC**	**DInC**	**BM=0.5**	**PT=0.4142**
P=4	TP=4	FN=0	TPR=1	FNR=0
N=4	FP=2	TN=2	FPR=0.5	TNR=0.5
Prev=0.5	PPV=0.6667	NPV=1	LR^{+}=2	LR^{-}=0
Acc=0.75	FDR=0.3333	FOR=0	MK=0.6667	DOR —
BalAcc=0.75	F_1 score=0.8	FMI=0.8165	MCC=0.5774	TS score=0.6667

$p_0 = 3.968 \times 10^{-8}$; $p_1 = 1.9992 \times 10^{-7}$; Contribution to expected losses from false discoveries = 0.00004708.; Contribution to expected losses from false omissions = 0.

Table 14: Confusion matrix for (TP,FN,FP,TN)=(3,1,0,4)

T=8	**DOutC**	**DInC**	**BM=0.75**	**PT=0**
P=4	TP=3	FN=1	TPR=0.75	FNR=0.25
N=4	FP=0	TN=4	FPR=0	TNR=1
Prev=0.5	PPV=1	NPV=0.8	LR^{+} —	LR^{-} =0.25
Acc=0.875	FDR=0	FOR=0.2	MK=0.8	DOR —
BalAcc=0.875	F_1 score=0.8571	FMI=0.866	MCC=0.7746	TS score=0.75

$p_0 = 9.60752 \times 10^{-5}$; $p_1 = 1.16824 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.; Contribution to expected losses from false omissions = 0.001371514.

Table 15: Confusion matrix for (TP,FN,FP,TN)=(3,1,1,3)

T=8	**DOutC**	**DInC**	**BM=0.5**	**PT=0.366**
P=4	TP=3	FN=1	TPR=0.75	FNR=0.25
N=4	FP=1	TN=3	FPR=0.25	TNR=0.75
Prev=0.5	PPV=0.75	NPV=0.75	LR^{+} =3	LR^{-} =0.3333
Acc=0.75	FDR=0.25	FOR=0.25	MK=0.5	DOR=9
BalAcc=0.75	F_1 score=0.75	FMI=0.75	MCC=0.5	TS score=0.6

$p_0 = 1.05251 \times 10^{-5}$; $p_1 = 1.12392 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.009367357; Contribution to expected losses from false omissions = 0.001649353

Table 16: Confusion matrix for (TP,FN,FP,TN)=(3,1,2,2)

T=8	**DOutC**	**DInC**	**BM=0.25**	**PT=0.4495**
P=4	TP=3	FN=1	TPR=0.75	FNR=0.25
N=4	FP=2	TN=2	FPR=0.5	TNR=0.5
Prev=0.5	PPV=0.6	NPV=0.6667	LR^{+} = 1.5	LR^{-} = 0.5
Acc=0.625	FDR=0.4	FOR=0.3333	MK=0.2667	DOR=3
BalAcc=0.625	F_1 score=0.6667	FMI=0.6708	MCC=0.2582	TS score=0.5

$p_0 = 2.7776 \times 10^{-7}$; $p_1 = 2.5856 \times 10^{-7}$; Contribution to expected losses from false discoveries = 0.00039553.; Contribution to expected losses from false omissions = 0.000505865.

Table 17: Confusion matrix for (TP,FN,FP,TN)=(2,2,0,4)

T=8	**DOutC**	**DInC**	**BM=0.5**	**PT=0**
P=4	TP=2	FN=2	TPR=0.5	FNR=0.5
N=4	FP=0	TN=4	FPR=0	TNR=1
Prev=0.5	PPV=1	NPV=0.6667	LR^{+} —	LR^{-} =0.5
Acc=0.75	FDR=0	FOR=0.3333	MK=0.6667	DOR —
BalAcc=0.75	F_1 score=0.6667	FMI=0.7071	MCC=0.5774	TS score=0.5

$p_0 = 0.000175048$; $p_1 = 2.6504 \times 10^{-7}$; Contribution to expected losses from false discoveries = 0.; Contribution to expected losses from false omissions = 0.000518543.

Table 18: Confusion matrix for (TP,FN,FP,TN) = (2,2,1,3)

T=8	**DOutC**	**DInC**	**BM=0.25**	**PT=0.4142**
P=4	TP=2	FN=2	TPR=0.5	FNR=0.5
N=4	FP=1	TN=3	FPR=0.25	TNR=0.75
Prev=0.5	PPV=0.6667	NPV=0.6	LR^{+}=2	LR^{-}=0.6667
Acc=0.625	FDR=0.3333	FOR=0.4	MK=0.2667	DOR=3
BalAcc=0.625	F_1 score=0.5714	FMI=0.5774	MCC=0.2582	TS score=0.4

$p_0 = 1.91754 \times 10^{-5}$; $p_1 = 2.5496 \times 10^{-7}$; Contribution to expected losses from false discoveries = 0.022752485; Contribution to expected losses from false omissions = 0.000598646

Table 19: Confusion matrix for (TP,FN,FP,TN)=(2,2,2,2)

T=8	**DOutC**	**DInC**	**BM=0**	**PT —**
P=4	TP=2	FN=2	TPR=0.5	FNR=0.5
N=4	FP=2	TN=2	FPR=0.5	TNR=0.5
Prev=0.5	PPV=0.5	NPV=0.5	LR^{+}=1	LR^{-}=1
Acc=0.5	FDR=0.5	FOR=0.5	MK=0	DOR=1
BalAcc=0.5	F_1 score=0.5	FMI=0.5	MCC=0	TS score=0.3333

$p_0 = 5.1584 \times 10^{-7}$; $p_1 = 5.864 \times 10^{-8}$; Contribution to expected losses from false discoveries = 0.000918195; Contribution to expected losses from false omissions = 0.000172108

Balancing the expected losses with the pattern probabilities reported in Tables 11-19, we find that the contributions of these patterns to expected losses are € 0.03451 from false discoveries and €0.00482 from false omissions.

5 SUSPECT 8-ARY CODES WITH TWO PS (EITHER TP OR FP) AMONG THE INITIAL FOUR CODES

Analysis of Tables 55-60 in Appendix C shows that when two Ps occur within the first four observations of the initial section, there are 16 possible (TP, FP, FN, TN) classification outcomes, as summarized in Table 20.

Table 20: Patterns when there exists two Ps in the first four positions

TP	**FP**	**FN**	**TN**	**Number of Cases**	**p|H0**	**p|H1**
5	0	0	3	6	0.00000102	0.00095046
5	0	1	2	12	0.00000016	0.00093800
5	0	2	1	7	0.00000002	0.00024148
5	0	3	0	1	0.00000000	0.00001011
4	1	0	3	15	0.00000805	0.00131872
4	1	1	2	31	0.00000115	0.00145020
4	1	2	1	19	0.00000019	0.00043729
4	1	3	0	3	0.00000001	0.00002320
3	2	0	3	12	0.00001809	0.00039448
3	2	1	2	26	0.00000238	0.00065831
3	2	2	1	17	0.0000004478	0.000276998
3	2	3	0	3	0.0000000233	0.0000160500
2	3	0	3	3	0.0000082902	0.0000262228
2	3	1	2	7	0.0000013342	0.000146112
2	3	2	1	5	0.0000002728	0.0000811847
2	3	3	0	1	0.0000000150	0.0000029679
				168	4.14533×10^{-5}	6.97179×10^{-3}

p1/p0 = 1.35632

Based on the probabilities of the 16 possible (TP, FP, FN, TN) patterns and the corresponding false discovery (FDR) and false omission (FOR) rates, the estimated contributions to expected losses are €0.10969 from false discoveries and €1.81982 from false omissions.

Table 21: Confusion matrix for (TP,FN,FP,TN)=(5,0,0,3)

T=8	**DOutC**	**DInC**	**BM=1**	**PT=0**
P=5	TP=5	FN=0	TPR=1	FNR=0
N=3	FP=0	TN=3	FPR=0	TNR=1
Prev=0.625	PPV=1	NPV=1	LR^+ —	LR^- =0
Acc=1	FDR=0	FOR=0	MK=1	DOR —
BalAcc=1	F_1 score=1	FMI=1	MCC=1	TS score=1

Parameters: $p_0 = 1.01184 \times 10^{-6}$; $p_1 = 7.60368 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0; Contribution to expected losses from false omissions = 0

Table 22: Confusion matrix for (TP,FN,FP,TN)=(5,0,1,2)

T=8	**DOutC**	**DInC**	**BM=0.6667**	**PT=0.3660**
P=5	TP=5	FN=0	TPR=1	FNR=0
N=3	FP=1	TN=2	FPR=0.3333	TNR=0.6667
Prev=0.625	PPV=0.8333	NPV=1	LR^+ =3	LR^- =0
Acc=0.875	FDR=0.1667	FOR=0	MK=0.8333	DOR —
BalAcc=0.8333	F_1 score=0.9091	FMI=0.9129	MCC=0.7454	TS score=0.8333

Parameters: $p_0 = 1.5872 \times 10^{-7}$; $p_1 = 7.504 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.00113031; Contribution to expected losses from false omissions = 0

Table23: Confusion matrix for (TP,FN,FP,TN)=(5,0,2,1)

T=8	**DOutC**	**DInC**	**BM=0.3333**	**PT=0.4495**
P=5	TP=5	FN=0	TPR=1	FNR=0
N=3	FP=2	TN=1	FPR=0.6667	TNR=0.3333
Prev=0.625	PPV=0.7143	NPV=1	LR+ =1.5	LR- =0
Acc=0.75	FDR=0.2857	FOR=0	MK=0.7143	DOR —
BalAcc=0.6667	F1 score=0.8333	FMI=0.8452	MCC=0.4880	TS score=0.7143

Parameters: $p_0 = 1.984 \times 10^{-8}$; $p_1 = 1.93184 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.00014125; Contribution to expected losses from false omissions = 0

Table24: Confusion matrix for (TP,FN,FP,TN)=(5,0,3,0)

T=8	**DOutC**	**DInC**	**BM=0**	**PT ---**
P=5	TP=5	FN=0	TPR=1	FNR=0
N=3	FP=3	TN=0	FPR=1	TNR=0
Prev=0.625	PPV=0.625	NPV —	LR^+ =1	LR^- —
Acc=0.625	FDR=0.375	FOR —	MK —	DOR—
BalAcc=0.5	F_1 score=0.7692	FMI=0.7906	MCC —	TS score=0.625

Parameters: $p_0 = 1.12324 \times 10^{-9}$; $p_1 = 8.088 \times 10^{-8}$; Contribution to expected losses from false discoveries = 0.0000015; Contribution to expected losses from false omissions = —

Table 25: Confusion matrix for (TP,FN,FP,TN)=(4,1,0,3)

T=8	**DOutC**	**DInC**	**BM=0.8**	**PT=0**
P=5	TP=4	FN=1	TPR=0.8	FNR=0.2
N=3	FP=0	TN=3	FPR=0	TNR=1
Prev=0.625	PPV=1	NPV=0.75	LR^+ —	LR^- =0.2
Acc=0.875	FDR=0	FOR=0.25	MK=0.75	DOR —
BalAcc=0.9	F_1 score=0.8889	FMI=0.8944	MCC=0.7746	TS score=0.8

Parameters: $p_0 = 7.9856 \times 10^{-6}$; $p_1 = 1.05498 \times 10^{-5}$; Contribution to expected losses from false discoveries = 0; Contribution to expected losses from false omissions = 0.23222659

Table 26: Confusion matrix for (TP,FN,FP,TN)=(4,1,1,2)

T=8	**DOutC**	**DInC**	**BM=0.4667**	**PT=0.3923**
P=5	TP=4	FN=1	TPR=0.8	FNR=0.2
N=3	FP=1	TN=2	FPR=0.3333	TNR=0.6667
Prev=0.625	PPV=0.8	NPV=0.6667	LR^+ =2.4	LR^- =0.3
Acc=0.75	FDR=0.2	FOR=0.3333	MK=0.4667	DOR =8
BalAcc=0.7333	F_1 score=0.8	FMI=0.8	MCC=0.4667	TS score=0.6667

Parameters: $p_0 = 1.1408 \times 10^{-6}$; $p_1 = 1.16016 \times 10^{-5}$; Contribution to expected losses from false discoveries = 0.02517974; Contribution to expected losses from false omissions = 0.70364401

Table 27: Confusion matrix for (TP,FN,FP,TN)=(4,1,2,1)

T=8	**DOutC**	**DInC**	**BM=0.1333**	**PT=0.4772**
P=5	TP=4	FN=1	TPR=0.8	FNR=0.2
N=3	FP=2	TN=1	FPR=0.6667	TNR=0.3333
Prev=0.625	PPV=0.6667	NPV=0.5	LR^+ =1.2	LR^- =0.6
Acc=0.625	FDR=0.3333	FOR=0.5	MK=0.1667	DOR =2
BalAcc=0.5667	F_1 score=0.7273	FMI=0.7303	MCC=0.1491	TS score=0.5714

Parameters: $p_0 = 1.8848 \times 10^{-7}$; $p_1 = 3.49832 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.00424917; Contribution to expected losses from false omissions = 0.19508381

Table 28: Confusion matrix for (TP,FN,FP,TN)=(4,1,3,0)

T=8	**DOutC**	**DInC**	**BM=-0.2**	**PT=0.5279**
P=5	TP=4	FN=1	TPR=0.8	FNR=0.2
N=3	FP=3	TN=0	FPR=1	TNR=0
Prev=0.625	PPV=0.5714	NPV=0	LR^+ =0.8	LR^- —
Acc=0.5	FDR=0.4286	FOR=1	MK=-0.4286	DOR —
BalAcc=0.4	F_1 score=0.6667	FMI=0.6761	MCC=-0.2928	TS score=0.5

Parameters: $p_0 = 9.92 \times 10^{-9}$; $p_1 = 1.856 \times 10^{-7}$; Contribution to expected losses from false discoveries = 0.000045408; Contribution to expected losses from false omissions = 0.00326842

Table 29: Confusion matrix for (TP,FN,FP,TN)=(3,2,0,3)

T=8	**DOutC**	**DInC**	**BM=0.6**	**PT=0**
P=5	TP=3	FN=2	TPR=0.6	FNR=0.4
N=3	FP=0	TN=3	FPR=0	TNR=1
Prev=0.625	PPV=1	NPV=0.6	LR^{+} —	LR^{-} =0.4
Acc=0.75	FDR=0	FOR=0.4	MK=0.6	DOR—
BalAcc=0.8	F_1 score=0.75	FMI=0.7746	MCC=0.6	TS score=0.6

Parameters: $p_0 = 1.79453 \times 10^{-5}$; $p_1 = 3.15584 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0; Contribution to expected losses from false omissions = 0.08891895

Table 30: Confusion matrix for (TP,FN,FP,TN)=(3,2,1,2)

T=8	**DOutC**	**DInC**	**BM=0.2667**	**PT=0.4271**
P=5	TP=3	FN=2	TPR=0.6	FNR=0.4
N=3	FP=1	TN=2	FPR=0.3333	TNR=0.6667
Prev=0.625	PPV=0.75	NPV=0.5	LR^{+} =1.8	LR^{-} =0.6
Acc=0.625	FDR=0.25	FOR=0.5	MK=0.25	DOR =3
BalAcc=0.6333	F_1 score=0.6667	FMI=0.6708	MCC=0.2582	TS score=0.5

Parameters: $p_0 = 2.36096 \times 10^{-6}$; $p_1 = 5.26648 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.05463261; Contribution to expected losses from false omissions = 0.40188509

Table 31: Confusion matrix for (TP,FN,FP,TN)=(3,2,2,1)

T=8	**DOutC**	**DInC**	**BM=-0.6667**	**PT=0.5132**
P=5	TP=3	FN=2	TPR=0.6	FNR=0.4
N=3	FP=2	TN=1	FPR=0.6667	TNR=0.3333
Prev=0.625	PPV=0.6	NPV=0.3333	LR^{+} =0.9	LR^{-} =1.2
Acc=0.5	FDR=0.4	FOR=0.6667	MK=-0.6667	DOR=0.75
BalAcc=0.4667	F_1 score=0.6	FMI=0.6	MCC=0.6667	TS score=0.42186

Parameters: $p_0 = 4.44218 \times 10^{-7}$; $p_1 = 2.21598 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.01075362; Contribution to expected losses from false omissions = 0.1474294

Table 32: Confusion matrix for (TP,FN,FP,TN)=(3,2,3,0)

T=8	**DOutC**	**DInC**	**BM=-0.4**	**PT=0.5635**
P=5	TP=3	FN=2	TPR=0.6	FNR=0.4
N=3	FP=3	TN=0	FPR=1	TNR=0
Prev=0.625	PPV=0.5	NPV=0	LR^{+} =0.6	LR^{-} —
Acc=0.375	FDR=0.5	FOR=1	MK=-0.5	DOR —
BalAcc=0.3	F_1 score=0.5455	FMI=0.5477	MCC=-0.4472	TS score=0.375

Parameters: $p_0 = 2.31136 \times 10^{-8}$; $p_1 = 1.284 \times 10^{-7}$; Contribution to expected losses from false discoveries = 0.00012343; Contribution to expected losses from false omissions = 0.00226112

Table 33: Confusion matrix for (TP,FN,FP,TN)=(2,3,0,3)

T=8	**DOutC**	**DInC**	**BM=0.4**	**PT=0**
P=5	TP=2	FN=3	TPR=0.4	FNR=0.6
N=3	FP=0	TN=3	FPR=0	TNR=1
Prev=0.625	PPV=1	NPV=0.5	LR^{+} —	LR^{-} =0.6
Acc=0.625	FDR=0	FOR=0.5	MK=0.5	DOR —
BalAcc=0.7	F_1 score=0.5714	FMI=0.6325	MCC=0.4472	TS score=0.4

Parameters: $p_0 = 8.22388 \times 10^{-6}$; $p_1 = 2.09782 \times 10^{-7}$; Contribution to expected losses from false discoveries = 0; Contribution to expected losses from false omissions = 0.00184713

Table 34: Confusion matrix for (TP,FN,FP,TN)=(2,3,1,2)

T=8	**DOutC**	**DInC**	**BM=0.0667**	**PT=0.4772**
P=5	TP=2	FN=3	TPR=0.4	FNR=0.6
N=3	FP=1	TN=2	FPR=0.3333	TNR=0.6667
Prev=0.625	PPV=0.6667	NPV=0.4	LR^{+} =1.2	LR^{-} =0.9
Acc=0.5	FDR=0.3333	FOR=0.6	MK=0.0667	DOR =1.3333
BalAcc=0.5333	F_1 score=0.5	FMI=0.5164	MCC=0.0667	TS score=1.3333

Parameters: $p_0 = 1.32353 \times 10^{-6}$; $p_1 = 1.1689 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.02881796; Contribution to expected losses from false omissions = 0.5146065

Table 35: Confusion matrix for (TP,FN,FP,TN)=(2,3,2,1)

T=8	**DOutC**	**DInC**	**BM=-0.2667**	**PT=0.5351**
P=5	TP=2	FN=3	TPR=0.4	FNR=0.6
N=3	FP=2	TN=1	FPR=0.6667	TNR=0.3333
Prev=0.625	PPV=0.5	NPV=0.25	LR^{+} =0.6	LR^{-} =1.8
Acc=0.375	FDR=0.5	FOR=0.75	MK=-0.25	DOR =0.3333
BalAcc=0.3667	F_1 score=0.4444	FMI=0.4472	MCC=-0.2582	TS score=0.2857

Parameters: $p_0 = 2.70618 \times 10^{-7}$; $p_1 = 6.49478 \times 10^{-7}$; Contribution to expected losses from false discoveries = 0.0024085; Contribution to expected losses from false omissions = 0.01429663

Table 36: Confusion matrix for (TP,FN,FP,TN)=(2,3,3,0)

T=8	**DOutC**	**DInC**	**BM=-0.6**	**PT=0.6126**
P=5	TP=2	FN=3	TP=0.4	FNR=0.6
N=3	FP=3	TN=0	FPR=1	TNR=0
Prev=0.625	PPV=0.4	NPV=0	LR^{+} =0.4	LR^{-} —
Acc=0.25	FDR=0.6	FOR=1	MK=-0.6	DOR —
BalAcc=0.2	F_1 score=0.4	FMI=0.4	MCC=-0.6	TS score=0.25

Parameters: $p_0 = 1.488 \times 10^{-8}$; $p_1 = 2.37432 \times 10^{-8}$; Contribution to expected losses from false discoveries = 0.000031784; Contribution to expected losses from false omissions = 1.81981849

6 SUSPECT 8-ARY CODES WITH THREE PS (EITHER TP OR FP) AMONG THE INITIAL FOUR CODES

From Tables 61 and 62 in Appendix D, we conclude that when one P occurs among the first four observations of the initial section, there are 12 possible (TP, FP, FN, TN) combinations, as summarized in Table 37.

Table 37: Patterns with 6 Ps in the 8-ary coding

TP	FP	FN	TN	Number of Cases	p | H0	p | H1
6	0	0	2	2	4.41859 × 10^-7	0.002892010
6	0	1	1	4	5.56801 × 10^-8	0.003362541
6	0	2	0	2	1.75411 × 10^-9	0.000977407
5	1	0	2	6	3.68808 × 10^-6	0.004589173
5	1	1	1	12	4.64747 × 10^-7	0.005335832
5	1	2	0	6	1.46411 × 10^-8	0.001550993
4	2	0	2	6	9.27681 × 10^-6	0.001946155
4	2	1	1	12	1.16900 × 10^-6	0.002262795
4	2	2	0	6	3.68274 × 10^-8	0.000657738
3	3	0	2	2	6.21225 × 10^-6	0.000248993
3	3	1	1	4	7.82826 × 10^-7	0.000289504
3	3	2	0	2	2.46616 × 10^-8	0.000289504
					2.21691 × 10^-5	0.024197293

p1 / p0 = 8.80

The likelihood ratio $p_1/p_0 = 8.80$ indicates that observing such 8-ary sequences strongly suggests the system is OutC. However, the presence of auxiliary patterns and the results of the change-point test may modify this assessment. On average, a suspicious 6P sequence contributes € 0.00191 to expected losses from false discoveries and € 0.44701 from false omissions.

Table 38: Confusion matrix for (TP,FN,FP,TN)=(6,0,0,2)

T=8	DOutC	DInC	BM=1	PT=0
P=6	TP=6	FN=0	TPR=1	FNR=0
N=2	FP=0	TN=2	FPR=0	TNR=1
Prev=0.75	PPV=1	NPV=1	LR^+ —	LR^- =0
Acc=1	FDR=0	FOR=0	MK=1	DOR —
BalAcc=1	F_1 score=1	FMI=1	MCC=1	TS score=1

$p_0 = 4.38324 \times 10^{-7}$; $p_1 = 2.31361 \times 10^{-5}$; Contribution to expected losses from false discoveries = 0.; Contribution to expected losses from false omissions = 0.

Table 39: Confusion matrix for (TP,FN,FP,TN)=(6,0,1,1)

T=8	DOutC	DInC	BM=0.5	PT=0.4142
P=6	TP=6	FN=0	TPR=1	FNR=0
N=2	FP=1	TN=1	FPR=0.5	TNR=0.5
Prev=0.75	PPV=0.8571	NPV=1	LR^+ =2	LR^- =0
Acc=0.875	FDR=0.1486	FOR=0	MK=0.8571	DOR —
BalAcc=0.75	F_1 score=0.9231	FMI=0.9258	MCC=0.6547	TS score=0.8571

$p_0 = 5.52347 \times 10^{-8}$; $p_1 = 2.69003 \times 10^{-5}$; Contribution to expected losses from false discoveries = 0.0000292. Contribution to expected losses from false omissions = 0.

Table 40: Confusion matrix for (TP,FN,FP,TN)=(6,0,2,0)

T=8	**DOutC**	**DInC**	**BM=0**	**PT ---**
P=6	TP=6	FN=0	TPR=1	FNR=0
N=2	FP=2	TN=0	FPR=1	TNR=0
Prev=0.75	PPV=0.75	NPV —	LR^+ =1	LR^- —
Acc=0.75	FDR=0.25	FOR —	MK —	DOR —
BalAcc=0.5	F_1 score=0.8571	FMI=0.8660	MCC—	TS score=0.75

$p_0 = 1.74008 \times 10^{-9}$; $p_1 = 7.81926 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.0000015. Contribution to expected losses from false omissions = —

Table 41: Confusion matrix for (TP,FN,FP,TN)=(5,1,0,2)

T=8	**DOutC**	**DInC**	**BM=0.8333**	**PT=0**
P=6	TP=5	FN=1	TPR=0.8333	FNR=1.6667
N=2	FP=0	TN=2	FPR=0	TNR=1
Prev=0.75	PPV=1	NPV=0.6667	LR^+ —	LR^- =0.1667
Acc=0.875	FDR=0	FOR=0.3333	MK=0.6667	DOR —
BalAcc=0.9167	F_1 score=0.9091	FMI=0.9129	MCC=0.7454	TS score=0.8333

$p_0 = 3.65858 \times 10^{-6}$; $p_1 = 3.67134 \times 10^{-5}$; Contribution to expected losses from false discoveries = 0.; Contribution to expected losses from false omissions = 0.0718287.

Table 42: Confusion matrix for (TP,FN,FP,TN)=(5,1,1,1)

T=8	**DOutC**	**DInC**	**BM=0.3333**	**PT=0.4365**
P=6	TP=5	FN=1	TPR=0.8333	FNR=0.1667
N=2	FP=1	TN=1	FPR=0.5	TNR=0.5
Prev=0.75	PPV=0.8333	NPV=0.5	LR^+ =1.6667	LR^- =0.3333
Acc=0.75	FDR=0.1667	FOR=0.5	MK=0.3333	DOR=5
BalAcc=0.6667	F_1 score=0.8333	FMI=0.8333	MCC=0.3333	TS score=0.7143

$p_0 = 4.61029 \times 10^{-7}$; $p_1 = 4.26867 \times 10^{-5}$; Contribution to expected losses from false discoveries = 0.0002736.; Contribution to expected losses from false omissions = 0.1252853.

Table 43: Confusion matrix for (TP,FN,FP,TN)=(5,1,2,0)

T=8	**DOutC**	**DInC**	**BM=-0.1667**	**PT=0.5228**
P=6	TP=5	FN=1	TPR=0.8333	FNR=0.1667
N=2	FP=2	TN=0	FPR=1	TNR=0
Prev=0.75	PPV=0.7143	NPV=0	LR^+ =0.8333	LR^- —
Acc=0.625	FDR=0.2857	FOR=1	MK=-0.2857	DOR —
BalAcc=0.4167	F_1 score=0.7692	FMI=0.7715	MCC=-0.2182	TS score=0.625

$p_0 = 1.4524 \times 10^{-8}$; $p_1 = 1.24079 \times 10^{-5}$; Contribution to expected losses from false discoveries = 0.0000148.; Contribution to expected losses from false omissions = 0.0728346.

Table 44: Confusion matrix for (TP,FN,FP,TN)=(4,2,0,2)

T=8	**DOutC**	**DInC**	**BM=0.6667**	**PT=0**
P=6	TP=4	FN=2	TPR=0.6667	FNR=0.3333
N=2	FP=0	TN=2	FPR=0	TNR=1
Prev=0.75	PPV=1	NPV=0.5	LR^+ —	LR^- =0.3333
Acc=0.75	FDR=0	FOR=0.5	MK=0.5	DOR —
BalAcc=0.8333	F_1 score=0.8	FMI=0.8165	MCC=0.5774	TS score=0.6667

$p_0 = 9.2026 \times 10^{-6}$; $p_1 = 1.55692 \times 10^{-5}$; Contribution to expected losses from false discoveries = 0.; Contribution to expected losses from false omissions = 0.0456957.

Table 45: Confusion matrix for (TP,FN,FP,TN)=(4,2,1,1)

T=8	**DOutC**	**DInC**	**BM=0.1667**	**PT=0.4641**
P=6	TP=4	FN=2	TPR=0.6667	FNR=0.3333
N=2	FP=1	TN=1	FPR=0.5	TNR=0.5
Prev=0.75	PPV=0.8	NPV=0.3333	LR^+ =1.3333	LR^- =0.6667
Acc=0.625	FDR=0.2	FOR=0.6667	MK=0.1333	DOR=2
BalAcc=0.5833	F_1 score=0.7272	FMI=0.7303	MCC=0.1491	TS score=0.5714

$p_0 = 1.15965 \times 10^{-6}$; $p_1 = 1.81024 \times 10^{-5}$; Contribution to expected losses from false discoveries = 0.0008257.; Contribution to expected losses from false omissions = 0.0708441.

Table 46: Confusion matrix for (TP,FN,FP,TN)=(4,2,2,0)

T=8	**DOutC**	**DInC**	**BM=-0.3333**	**PT=0.5505**
P=6	TP=4	FN=2	TPR=0.6667	FNR=0.3333
N=2	FP=2	TN=0	FPR=1	TNR=0
Prev=0.75	PPV=0.6667	NPV=0	LR^+ =0.6667	LR^- —
Acc=0.5	FDR=0.3333	FOR=1	MK=-0.3333	DOR —
BalAcc=0.3333	F_1 score=0.6667	FMI=0.6667	MCC=-0.3333	TS score=0.5

$p_0 = 3.65328 \times 10^{-8}$; $p_1 = 5.2619 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.0000433.; Contribution to expected losses from false omissions = 0.0308874.

Table 47: Confusion matrix for (TP,FN,FP,TN)=(3,3,0,2)

T=8	**DOutC**	**DInC**	**BM=0.5**	**PT=0**
P=6	TP=3	FN=3	TPR=0.5	FNR=0.5
N=2	FP=0	TN=2	FPR=0	TNR=1
Prev=0.75	PPV=1	NPV=0.4	LR^+ —	LR^- =0.5
Acc=0.625	FDR=0	FOR=0.6	MK=0.4	DOR —
BalAcc=0.75	F_1 score=0.6667	FMI=0.7071	MCC=0.4472	TS score=0.5

$p_0 = 6.16255 \times 10^{-6}$; $p_1 = 1.99194 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.; Contribution to expected losses from false omissions = 0.0058464.

Table 48: Confusion matrix for (TP,FN,FP,TN)=(3,3,1,1)

T=8	**DOutC**	**DInC**	**BM=0**	**PT ---**
P=6	TP=3	FN=3	TPR=0.5	FNR=0.5
N=2	FP=1	TN=1	FPR=0.5	TNR=0.5
Prev=0.75	PPV=0.75	NPV=0.25	LR^+ =1	LR^- =1
Acc=0.5	FDR=0.25	FOR=0.75	MK=0	DOR=1
BalAcc=0.5	F_1 score=0.6	FMI=0.6123	MCC=0	TS score=0.4286

$p_0 = 7.76563 \times 10^{-7}$; $p_1 = 2.31603 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.0006911.; Contribution to expected losses from false omissions = 0.0101963.

Table 49: Confusion matrix for (TP,FN,FP,TN)=(3,3,2,0)

T=8	**DOutC**	**DInC**	**BM=-0.5**	**PT=0.5858**
P=6	TP=3	FN=3	TPR=0.5	FNR=0.5
N=2	FP=2	TN=0	FPR=1	TNR=0
Prev=0.75	PPV=0.6	NPV=0	LR^+ =0.5	LR^- —
Acc=0.625	FDR=0.4	FOR=1	MK=-0.4	DOR—
BalAcc=0.25	F_1 score=0.5455	FMI=0.5477	MCC=-0.4472	TS score=0.375

$p_0 = 2.44643 \times 10^{-8}$; $p_1 = 2.31603 \times 10^{-6}$; Contribution to expected losses from false discoveries = 0.0000348.; Contribution to expected losses from false omissions = 0.0135951.;

7 SCORING AND CLUSTERING OF OUTC SYMPTOMS USING MOVING AVERAGES

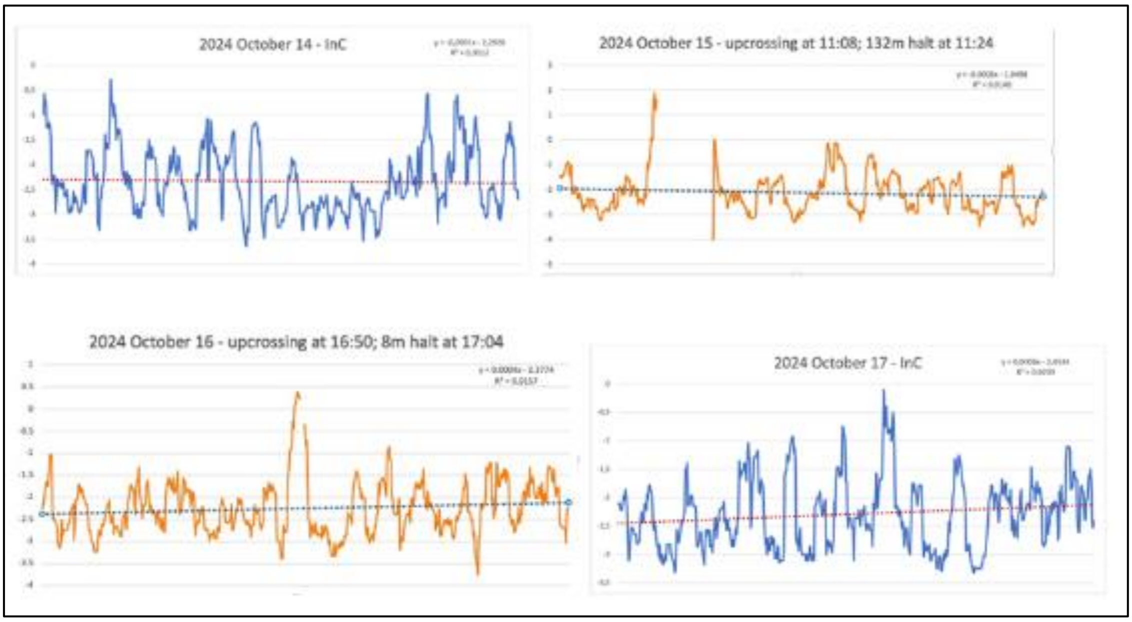

Figure 2: Moving averages score time series for selected dates

The use of color coding instead of temperature values loses plenty of information. Nonetheless, the results clearly indicate that sequences containing four or fewer Ps are generally expected under InC conditions, whereas sequences with five or more Ps signal a potential risk of OutC operation. Importantly, only the accumulation of evidence from clustered occurrences of such sequences should be considered a reliable alarm.

Therefore, it is obviously wise to assign positive scores to 8-ary sequences dominated by P temperatures and negative scores to sequences dominated by N temperatures. Since shifts from InC to OutC are expected to manifest as clusters of

P observations, the scoring weights were chosen so that the moving averages of scores — typically negative under InC — cross zero when significant disturbances occur, thereby indicating a shift to OutC.

Daily half-hour (15-sequence) moving averages, as illustrated in Figure 2 (blue for InC days, orange for days with OutC events and 0-upcrossings), clearly show that clustering of suspicious sequences leading to 0-upcrossings is closely associated with production halts for maintenance or repair, thus having notable prognostic value [1, 2]. However, some two-minute halts may reflect false discoveries or minor, easily resolved issues.

The determination coefficients R^2 of sequential temperature readings, listed in Table 50, support the view that feedback and control effectively maintain approximate independence, cf. [15] on subindependence.. This supports the straightforward computation of pattern probabilities under both InC and OutC conditions, as detailed in Appendices B, C, and D.

Table 50: Determination coefficients R^2

0.0018	**0.0200**	**0.0539**	**0.0297**	**0.0351**	**0.0189**	**0.0012**
0.0035	0.0071	0.0008	0.0012	0.0146	0.0157	0.0239
0.0011	0.0675	0.0001	0.0137	0.0552	0.0074	0.0020
0.0072	0.0310	0.0054	0.0553	2.0×10^{-8}	0.0029	0.0614
0.0034	0.0239	0.0036	0.0158	0.0140	0.0122	0.0096
0.0805	0.0088	0.0617	0.0413	0.0269	0.0006	0.0133
0.0011	0.0495	0.0103	0.0764	0.0226	0.0350	0.0029
0.0004	0.0058	0.0086	0.0022	0.0446	0.0016	0.0005
0.0102	0.0351	0.0059	0.0368	0.0242	0.0188	0.0039
0.0036	0.0251	0.0039	0.0018	0.1082	6.0×10^{-5}	

8 CONCLUSIONS

Our analysis has pointed the shortcomings resulting from Statistical Quality Control using nominal color recoded data, and from January 2025 onwards decisions were taken using the full information of the ratio scale temperatures data. Each reading, by itself, is mostly noise, only the accumulation of evidence obtained by moving averages of appropriate scores carries evident signal of whether the system is InC or has shifted to OutC. The prognostic value 0-upcrossing of scores moving averages clustering anticipates that a maintenance/repair team may have to intervene, and timely intervention saves money.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

REFERENCES

[1] Pestana, P., Brilhante, M.F.: A digital pheromone-based approach for in-control/out-of-control classification. Communications in Mathematics 34(1), 16690 (2026) https://doi.org/10.46298/cm.16690

[2] Pestana, D., Rocha, M.L.: Prognostic value of scoring and 0-upcrossing in Statistical Quality Control. AppliedMath. 6(5), 77 (2026) https://doi.org/10.3390/appliedmath6050077

[3] Pestana, P., Rocha, M.L., Brilhante, M.F.: (Mis)classification for In-control/Out-of-Control decisions in Statistical Quality Control: A case study. Quality and Reliability Engineering International (2026)

[4] Stevens, S.S.: On the theory of scales of measurement. Science 103(2684), 67-680 (1946) https://doi.org/10.1126/science.103.2684.677

[5] Louis, R.: Custom Kanban: Designing the System to Meet the Needs of your Environment. Productivity Press, University Park, IL (2006)

[6] Stehman, S.V.: Selecting and interpreting measures of thematic classification accuracy. Remote Sensing of Environment 62(1), 77-89 (1997) https://doi.org/10.1016/S0034-4257(97)00083-7

[7] Powers, D.M.: Evaluation: From precision, recall and F-measure to ROC, informedness, markedness & correlation. Journal of Machine Learning Technologies 2(1), 37-63 (2011) https://doi.org/10.9735/2229-3981

[8] Ting, K.M.: Error rate. In: Sammut, C., Webb, G.I. (eds.) Encyclopedia of Machine Learning, p. 331. Springer, Boston, USA (2011). https://doi.org/10.1007/978-0-387-30164-8 262

[9] Ting, K.M.: Confusion matrix. In: Sammut, C., Webb, G.I. (eds.) Encyclopedia of Machine Learning and Data Mining, p. 1. Springer, Boston, US (2016). https://doi.org/10.1007/978-1-4899-7502-7 50-1

[10] Ting, K.M.: Sensitivity and specificity. In: Sammut, C., Webb, G.I. (eds.) Encyclopedia of Machine Learning, pp. 901-902. Springer, Boston, USA (2011). https://doi.org/10.1007/978-0-387-30164-8 752

[11] Tharwat, A.: Classification assessment methods. Applied Computing and Informatics 17, 168-192 (2018) https://doi.org/10.1016/j.aci.2018.08.003

[12] Chicco, D., Jurman, G.: The advantages of the Matthews correlation coefficient (MCC) over F1 score and accuracy in binary classification evaluation. BMC Genomics 21(1) (2020) https://doi.org/10.1186/s12864-019-6413-7

[13] Chicco, D., T¨otsch, N., Jurman, G.: The Matthews correlation coefficient (MCC) is more reliable than balanced accuracy, bookmaker informedness, and markedness in two-class confusion matrix evaluation. BioData Mining 4(14), 13 (2021) https://doi.org/10.1186/s13040-021-00244-z

[14] Opitz, J.: A closer look at classification evaluation metrics and a critical reflection of common evaluation practice. Transactions of the Association for Computational Linguistics 12, 820–836 (2024) https://doi.org/10.1162/tacl a 00675

[15] Hamedani, G. G. (2013). Sub-Independence: An Expository Perspective. Communications in Statistics - Theory and Methods, 42(20), 3615-3638. https://doi.org/10.1080/03610926.2011.620214

APPENDICES

Python implementation for color coding

```
def classify tn tp fn fp np(t series):

import numpy as np

t = np.asarray(t series, dtype=float)

n = len(t)

# Subsequent values (NaN for last)
```

```
subsequent = np.empty like(t)
subsequent[:-1] = t[1:]
subsequent[-1] = np.nan
# Start with all None
labels = np.array([None] * n, dtype=object)
# === TN Rules ===
tn mask = (
((t ¿= 176) & (t ¡= 184)) —
((t ¿ 184) & (t ¡= 185) & (subsequent ¡ 185)) —
((t ¿= 175) & (t ¡ 176) & (subsequent ¿ 175))
)
labels[tn mask] = ”TN”
# === TP Rules ===
tp mask = (
(t ¿= 188) —
((t ¿ 185) & (t ¡ 188) & (subsequent ¿ 188)) —
(t ¡= 170) —
((t ¿ 170) & (t ¡ 175) & (subsequent ¡ 175))
)
labels[t mask] = ”TP”
# === FN Rules ===
fn mask = (
((t ¿ 184) & (t ¡= 185) & (subsequent ¿= 185)) —
((t ¿= 175) & (t ¡ 176) & (subsequent ¡= 175))
)
labels[fn mask] = ”FN”
# === FP Rules ===
fp mask = (
((t ¿ 185) & (t ¡ 188) & (subsequent ¡= 185)) —
((t ¿ 170) & (t ¡ 175) & (subsequent ¿= 175))
)
```

labels[fp mask] = ”FP”

return labels

A. Patterns and probabilities of suspect 8-ary patterns with one P in the initial section

Tables 51–54 display the 8-ary sequences terminating with the codon PPP that contain a single P (either TP or FP) among the first four observations, allowing the computation of the corresponding approximate probabilities.

Table 51: The first value in the initial section is P (either TP or FP)

P	TN	TN	TN	N	TP	TP	P	$p\|H_0$	$p\|H_1$	TP	FP	FN	TN
🔴	🟢	🟢	🟢	🟢	🔴	🔴	🔴	0.00000348	0.00003897	4	0	0	4
🟡	🟢	🟢	🟢	🟢	🔴	🔴	🔴	0.00001267	0.00001143	3	1	0	4
🔴	🟢	🟢	🟢	🔵	🔴	🔴	🔴	0.00000022	0.00002266	4	0	1	3
🟡	🟢	🟢	🟢	🔵	🔴	🔴	🔴	0.00000080	0.00000665	3	1	1	3
🔴	🟢	🟢	🟢	🟢	🔴	🔴	🟡	0.00001267	0.00003897	3	1	0	4
🟡	🟢	🟢	🟢	🟢	🔴	🔴	🟡	0.00004617	0.00001143	2	2	0	4
🔴	🟢	🟢	🟢	🔵	🔴	🔴	🟡	0.00000080	0.00002266	3	1	1	3
🟡	🟢	🟢	🟢	🔵	🔴	🔴	🟡	0.00000291	0.00000665	2	2	1	3
								0.00007971	0.00015942				

Table 52: The second value in the initial section is P (either TP or FP)

N	P	TN	TN	N	TP	TP	P	p|H0	p|H1	TP	FP	FN	TN
🟢	🔴	🟢	🟢	🟢	🔴	🔴	🔴	0.00000327	0.00002464	4	0	0	4
🟢	🟡	🟢	🟢	🟢	🔴	🔴	🔴	0.00001192	0.00000723	3	1	0	4
🟢	🔴	🟢	🟢	🔵	🔴	🔴	🔴	0.00000021	0.00001433	4	0	1	3
🟢	🟡	🟢	🟢	🔵	🔴	🔴	🔴	0.00000075	0.00000420	3	1	1	3
🟢	🔴	🟢	🟢	🟢	🔴	🔴	🟡	0.00001192	0.00002464	3	1	0	4
🟢	🟡	🟢	🟢	🟢	🔴	🔴	🟡	0.00004343	0.00000723	2	2	0	4
🟢	🔴	🟢	🟢	🔵	🔴	🔴	🟡	0.00000075	0.00001433	3	1	1	3
🟢	🟡	🟢	🟢	🔵	🔴	🔴	🟡	0.00000274	0.00000420	2	2	1	3
🔵	🔴	🟢	🟢	🟢	🔴	🔴	🔴	0.00000021	0.00001433	4	0	1	3
🔵	🟡	🟢	🟢	🟢	🔴	🔴	🔴	0.00000075	0.00000420	3	1	1	3
🔵	🔴	🟢	🟢	🔵	🔴	🔴	🔴	0.00000001	0.00000833	4	0	2	2
🔵	🟡	🟢	🟢	🔵	🔴	🔴	🔴	0.00000005	0.00000244	3	1	2	2
🔵	🔴	🟢	🟢	🟢	🔴	🔴	🟡	0.00000075	0.00001433	3	1	1	3
🔵	🟡	🟢	🟢	🟢	🔴	🔴	🟡	0.00000274	0.00000420	2	2	1	3
🔵	🔴	🟢	🟢	🔵	🔴	🔴	🟡	0.00000005	0.00000833	3	1	2	2
🔵	🟡	🟢	🟢	🔵	🔴	🔴	🟡	0.00000017	0.00000244	2	2	2	2
								0.00007971	0.00015942				

Table 53: The third value in the initial section is P (either TP or FP)

TN	N	P	TN	1N	TP	TP	P	p|H0	p|H1	TP	FP	FN	TN
🟢	🟢	🔴	🟢	🟢	🔴	🔴	🔴	0.00000327	0.00002464	4	0	0	4
🟢	🟢	🟡	🟢	🟢	🔴	🔴	🔴	0.00001192	0.00000723	3	1	0	4
🟢	🟢	🔴	🟢	🔵	🔴	🔴	🔴	0.00000021	0.00001433	4	0	1	3
🟢	🟢	🟡	🟢	🔵	🔴	🔴	🔴	0.00000075	0.00000420	3	1	1	3
🟢	🟢	🔴	🟢	🟢	🔴	🔴	🟡	0.00001192	0.00002464	3	1	0	4
🟢	🟢	🟡	🟢	🟢	🔴	🔴	🟡	0.00004343	0.00000723	2	2	0	4
🟢	🟢	🔴	🟢	🔵	🔴	🔴	🟡	0.00000075	0.00001433	3	1	1	3
🟢	🟢	🟡	🟢	🔵	🔴	🔴	🟡	0.00000274	0.00000420	2	2	1	3
🟢	🔵	🔴	🟢	🟢	🔴	🔴	🔴	0.00000021	0.00001433	4	0	1	3
🟢	🔵	🟡	🟢	🟢	🔴	🔴	🔴	0.00000075	0.00000420	3	1	1	3
🟢	🔵	🔴	🟢	🔵	🔴	🔴	🔴	0.00000001	0.00000833	4	0	2	2
🟢	🔵	🟡	🟢	🔵	🔴	🔴	🔴	0.00000005	0.00000244	3	1	2	2
🟢	🔵	🔴	🟢	🟢	🔴	🔴	🟡	0.00000075	0.00001433	3	1	1	3
🟢	🔵	🟡	🟢	🟢	🔴	🔴	🟡	0.00000274	0.00000420	2	2	1	3
🟢	🔵	🔴	🟢	🔵	🔴	🔴	🟡	0.00000005	0.00000833	3	1	2	2
🟢	🔵	🟡	🟢	🔵	🔴	🔴	🟡	0.00000017	0.00000244	2	2	2	2
								0.00007971	0.00015942				

Table 54: The fourth value in the initial section is P (either TP or FP)

TN	TN	N	P	N	TP	TP	P	$p\|H_0$	$p\|H_1$	TP	FP	FN	TN
🟢	🟢	🟢	🔴	🟢	🔴	🔴	🔴	0.00000327	0.00002464	4	0	0	4
🟢	🟢	🟢	🟡	🟢	🔴	🔴	🔴	0.00001192	0.00000723	3	1	0	4
🟢	🟢	🟢	🔴	🔵	🔴	🔴	🔴	0.00000021	0.00001433	4	0	1	3
🟢	🟢	🟢	🟡	🔵	🔴	🔴	🔴	0.00000075	0.00000420	3	1	1	3
🟢	🟢	🟢	🔴	🟢	🔴	🔴	🟡	0.00001192	0.00002464	3	1	0	4
🟢	🟢	🟢	🟡	🟢	🔴	🔴	🟡	0.00004343	0.00000723	2	2	0	4
🟢	🟢	🟢	🔴	🔵	🔴	🔴	🟡	0.00000075	0.00001433	3	1	1	3
🟢	🟢	🟢	🟡	🔵	🔴	🔴	🟡	0.00000274	0.00000420	2	2	1	3
🟢	🟢	🔵	🔴	🟢	🔴	🔴	🔴	0.00000021	0.00001433	4	0	1	3
🟢	🟢	🔵	🟡	🟢	🔴	🔴	🔴	0.00000075	0.00000420	3	1	1	3
🟢	🟢	🔵	🔴	🔵	🔴	🔴	🔴	0.00000001	0.00000833	4	0	2	2
🟢	🟢	🔵	🟡	🔵	🔴	🔴	🔴	0.00000005	0.00000244	3	1	2	2
🟢	🟢	🔵	🔴	🟢	🔴	🔴	🟡	0.00000075	0.00001433	3	1	1	3
🟢	🟢	🔵	🟡	🟢	🔴	🔴	🟡	0.00000274	0.00000420	2	2	1	3
🟢	🟢	🔵	🔴	🔵	🔴	🔴	🟡	0.00000005	0.00000833	3	1	2	2
🟢	🟢	🔵	🟡	🔵	🔴	🔴	🟡	0.00000017	0.00000244	2	2	2	2
								0.00007971	0.00015942				

Patterns and probabilities of suspect 8-ary patterns, two Ps in the initial section

Table 55 displays the eight possible patterns when the first and second observations are P (TP or FP), the probability of each sequence pattern, and the count of TP, FP, FN and TN.

Table 56 displays the thirty-two possible patterns when the first and third observations are P (TP or FP), the probability of each sequence pattern, and the count of TP, FP, FN and TN.

Table 57 displays the thirty-two possible patterns when the first and fourth observations are P (TP or FP), the probability of each sequence pattern, and the count of TP, FP, FN and TN.

Table 58 displays the sixteen possible patterns when the second and third observations are P (TP or FP), the probability of each sequence pattern, and the count of TP, FP, FN and TN.

Table 59 displays the sixteen possible patterns when the third and fourth observations are P (TP or FP), the probability of each sequence pattern, and the count of TP, FP, FN and TN.

Table 60 displays the sixty-four possible patterns when the second and fourth observations are P (TP or FP), the probability of each sequence pattern, and the count of TP, FP, FN and TN.

Table 55: The first and second values in the initial section are TP or FP

TP	P	TN	TN	N	TP	TP	P	p|H₀	p|H₁	TP	FP	FN	TN
🔴	🔴	🟢	🟢	🟢	🔴	🔴	🔴	4.10731×10^{-7}	0.00032990	5	0	0	3
🔴	🟡	🟢	🟢	🟢	🔴	🔴	🔴	1.49669×10^{-6}	0.00009680	4	1	0	3
🔴	🔴	🟢	🟢	🔵	🔴	🔴	🔴	2.58788×10^{-8}	0.00019179	5	0	1	2
🔴	🟡	🟢	🟢	🔵	🔴	🔴	🔴	9.43012×10^{-8}	0.00005627	4	1	1	2
🔴	🔴	🟢	🟢	🟢	🔴	🔴	🟡	1.49669×10^{-6}	0.00032990	4	1	0	3
🔴	🟡	🟢	🟢	🟢	🔴	🔴	🟡	5.45386×10^{-6}	0.00009680	3	2	0	3
🔴	🔴	🟢	🟢	🔵	🔴	🔴	🟡	9.43012×10^{-8}	0.00019179	4	1	1	2
🔴	🟡	🟢	🟢	🔵	🔴	🔴	🟡	3.43629×10^{-7}	0.00005627	3	2	1	2
								9.41608×10^{-6}	0.00134951				

Table 56: The first and third values in the initial section are TP or FP

TP	N	P	TN	N	TP	TP	P	p|H₀	p|H₁	TP	FP	FN	TN
🔴	🟢	🔴	🟢	🟢	🔴	🔴	🔴	8.32020×10^{-8}	0.00016129	5	0	0	3
🟡	🟢	🔴	🟢	🟢	🔴	🔴	🔴	3.03184×10^{-7}	0.00004733	4	1	0	3
🔴	🔵	🔴	🟢	🟢	🔴	🔴	🔴	5.24228×10^{-9}	0.00009377	5	0	1	2
🟡	🔵	🔴	🟢	🟢	🔴	🔴	🔴	1.91026×10^{-8}	0.00002751	4	1	1	2
🔴	🟢	🟡	🟢	🟢	🔴	🔴	🔴	3.03184×10^{-7}	0.00004733	4	1	0	3
🟡	🟢	🟡	🟢	🟢	🔴	🔴	🔴	1.10479×10^{-6}	0.00001389	3	2	0	3
🔴	🔵	🟡	🟢	🟢	🔴	🔴	🔴	1.91026×10^{-8}	0.00002751	4	1	1	2
🟡	🔵	🟡	🟢	🟢	🔴	🔴	🔴	6.96091×10^{-8}	0.00000807	3	2	1	2
🔴	🟢	🔴	🟢	🔵	🔴	🔴	🔴	5.24228×10^{-9}	0.00009377	5	0	1	2
🟡	🟢	🔴	🟢	🔵	🔴	🔴	🔴	1.91026×10^{-8}	0.00002751	4	1	1	2
🔴	🔵	🔴	🟢	🔵	🔴	🔴	🔴	3.30298×10^{-10}	0.00005451	5	0	2	1
🟡	🔵	🔴	🟢	🔵	🔴	🔴	🔴	1.20359×10^{-9}	0.00001599	4	1	2	1
🔴	🟢	🟡	🟢	🔵	🔴	🔴	🔴	1.91026×10^{-8}	0.00002751	4	1	1	2
🟡	🟢	🟡	🟢	🔵	🔴	🔴	🔴	6.96091×10^{-8}	0.00000807	3	2	1	2

🔴	🔵	🟡	🟢	🔵	🔴	🔴	🔴	1.20359×10^{-9}	0.00001599	4	1	2	1
🟡	🔵	🟡	🟢	🔵	🔴	🔴	🔴	4.38584×10^{-9}	0.00000469	3	2	2	1
🔴	🔵	🟡	🟢	🔵	🔴	🔴	🟡	4.38584×10^{-9}	0.00001599	3	2	2	1
🟡	🔵	🟡	🟢	🔵	🔴	🔴	🟡	1.59818×10^{-8}	0.00000469	2	3	2	1
🔴	🟢	🟡	🟢	🔵	🔴	🔴	🟡	6.96091×10^{-8}	0.00002751	3	2	1	2
🟡	🟢	🟡	🟢	🔵	🔴	🔴	🟡	2.53653×10^{-7}	0.00000807	2	3	1	2
🔴	🔵	🔴	🟢	🔵	🔴	🔴	🟡	1.20359×10^{-9}	0.00005451	4	1	2	1
🟡	🔵	🔴	🟢	🔵	🔴	🔴	🟡	4.38584×10^{-9}	0.00001599	3	2	2	1
🔴	🟢	🔴	🟢	🔵	🔴	🔴	🟡	1.91026×10^{-8}	0.00009377	4	1	1	2
🟡	🟢	🔴	🟢	🔵	🔴	🔴	🟡	6.96091×10^{-8}	0.00002751	3	2	1	2
🔴	🔵	🟡	🟢	🟢	🔴	🔴	🟡	6.96091×10^{-8}	0.00002751	3	2	1	2
🟡	🔵	🟡	🟢	🟢	🔴	🔴	🟡	2.53653×10^{-7}	0.00000807	2	3	1	2
🔴	🟢	🟡	🟢	🟢	🔴	🔴	🟡	1.10479×10^{-6}	0.00004733	3	2	0	3
🟡	🟢	🟡	🟢	🟢	🔴	🔴	🟡	4.02581×10^{-6}	0.00001389	2	3	0	3
🔴	🔵	🔴	🟢	🟢	🔴	🔴	🟡	1.91026×10^{-8}	0.00009377	4	1	1	2
🟡	🔵	🔴	🟢	🟢	🔴	🔴	🟡	6.96091×10^{-8}	0.00002751	3	2	1	2
🔴	🟢	🔴	🟢	🟢	🔴	🔴	🟡	3.03184×10^{-7}	0.00016129	4	1	0	3
🟡	🟢	🔴	🟢	🟢	🔴	🔴	🟡	1.10479×10^{-6}	0.00004733	3	2	0	3
								9.41608×10^{-6}	0.00134951				

Table 57: The first and fourth values in the initial section are TP or FP

P	TN	N	P	N	TP	TP	P	$p\|H_0$	$p\|H_1$	TP	FP	FN	TN
🔴	🟢	🟢	🔴	🟢	🔴	🔴	🔴	8.32020×10^{-8}	0.00002464	5	0	0	3
🟡	🟢	🟢	🔴	🟢	🔴	🔴	🔴	3.03184×10^{-7}	0.00002464	4	1	0	3
🔴	🟢	🔵	🟡	🟢	🔴	🔴	🔴	1.91026×10^{-8}	0.00000420	4	1	1	2
🟡	🟢	🔵	🟡	🟢	🔴	🔴	🔴	6.96091×10^{-8}	0.00000420	3	2	1	2
🔴	🟢	🟢	🔴	🔵	🔴	🔴	🔴	5.24228×10^{-9}	0.00001433	5	0	1	2
🟡	🟢	🟢	🔴	🔵	🔴	🔴	🔴	1.91026×10^{-8}	0.00001433	4	1	1	2
🔴	🟢	🔵	🟡	🔵	🔴	🔴	🔴	1.20359×10^{-9}	0.00000244	4	1	2	1
🟡	🟢	🔵	🟡	🔵	🔴	🔴	🔴	4.38584×10^{-9}	0.00000244	3	2	2	1
🔴	🟢	🟢	🔴	🟢	🔴	🔴	🟡	3.03184×10^{-7}	0.00002464	4	1	0	3
🟡	🟢	🟢	🔴	🟢	🔴	🔴	🟡	1.10479×10^{-6}	0.00002464	3	2	0	3
🔴	🟢	🔵	🟡	🟢	🔴	🔴	🟡	6.96091×10^{-8}	0.00000420	3	2	1	2
🟡	🟢	🔵	🟡	🟢	🔴	🔴	🟡	2.53653×10^{-7}	0.00000420	2	3	1	2
🔴	🟢	🟢	🔴	🔵	🔴	🔴	🟡	1.91026×10^{-8}	0.00001433	4	1	1	2
🟡	🟢	🟢	🔴	🔵	🔴	🔴	🟡	6.96091×10^{-8}	0.00001433	3	2	1	2
🔴	🟢	🔵	🟡	🔵	🔴	🔴	🟡	4.38584×10^{-9}	0.00000244	3	2	2	1
🟡	🟢	🔵	🟡	🔵	🔴	🔴	🟡	1.59818×10^{-8}	0.00000244	2	3	2	1
🟡	🟢	🔵	🔴	🟢	🔴	🔴	🟡	6.96091×10^{-8}	0.00001433	3	2	1	2
🔴	🟢	🔵	🔴	🟢	🔴	🔴	🟡	1.91026×10^{-8}	0.00001433	4	1	1	2
🟡	🟢	🟢	🟡	🟢	🔴	🔴	🟡	4.02581×10^{-6}	0.00000723	2	3	0	3
🔴	🟢	🟢	🟡	🟢	🔴	🔴	🟡	1.10479×10^{-6}	0.00000723	3	2	0	3

🟡	🟢	🔵	🔴	🔵	🔴	🔴	🟡	4.38584×10^{-9}	0.00000833	3	2	2	1
🔴	🟢	🔵	🔴	🔵	🔴	🔴	🟡	1.20359×10^{-9}	0.00000833	4	1	2	1
🟡	🟢	🟢	🟡	🔵	🔴	🔴	🟡	2.53653×10^{-7}	0.00000420	2	3	1	2
🔴	🟢	🟢	🟡	🔵	🔴	🔴	🟡	6.96091×10^{-8}	0.00000420	3	2	1	2
🟡	🟢	🔵	🔴	🟢	🔴	🔴	🔴	1.91026×10^{-8}	0.00001433	4	1	1	2
🔴	🟢	🔵	🔴	🟢	🔴	🔴	🔴	5.24228×10^{-9}	0.00001433	5	0	1	2
🟡	🟢	🟢	🟡	🟢	🔴	🔴	🔴	1.10479×10^{-6}	0.00000723	3	2	0	3
🔴	🟢	🟢	🟡	🟢	🔴	🔴	🔴	3.03184×10^{-7}	0.00000723	4	1	0	3
🟡	🟢	🔵	🔴	🔵	🔴	🔴	🔴	1.20359×10^{-9}	0.00000833	4	1	2	1
🔴	🟢	🔵	🔴	🔵	🔴	🔴	🔴	3.30298×10^{-10}	0.00000833	5	0	2	1
🟡	🟢	🟢	🟡	🔵	🔴	🔴	🔴	6.96091×10^{-8}	0.00000420	3	2	1	2
🔴	🟢	🟢	🟡	🔵	🔴	🔴	🔴	1.91026×10^{-8}	0.00000420	4	1	1	2
								9.41608×10^{-6}	0.00031884				

Table 58: The second and third values in the initial section are TP or FP

N	TP	P	TN	N	TP	TP	P	$p \mid H_0$	$p \mid H_1$	TP	FP	FN	TN
🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	3.86386×10^{-7}	0.00020862	5	0	0	3
🟢	🔴	🟠	🟢	🟢	🔴	🔴	🔴	1.40798×10^{-6}	0.00006121	4	1	0	3
🟢	🔴	🔴	🟢	🔵	🔴	🔴	🔴	2.43449×10^{-8}	0.00012128	5	0	1	2
🟢	🔴	🟠	🟢	🔵	🔴	🔴	🔴	8.87118×10^{-8}	0.00003559	4	1	1	2
🟢	🔴	🔴	🟢	🟢	🔴	🔴	🟠	1.40798×10^{-6}	0.00020862	4	1	0	3
🟢	🔴	🟠	🟢	🟢	🔴	🔴	🟠	5.13060×10^{-6}	0.00006121	3	2	0	3
🟢	🔴	🔴	🟢	🔵	🔴	🔴	🟠	8.87118×10^{-8}	0.00012128	4	1	1	2
🟢	🔴	🟠	🟢	🔵	🔴	🔴	🟠	3.23262×10^{-7}	0.00003559	3	2	1	2
🔵	🔴	🔴	🟢	🟢	🔴	🔴	🔴	2.43449×10^{-8}	0.00012128	5	0	1	2
🔵	🔴	🟠	🟢	🟢	🔴	🔴	🔴	8.87118×10^{-8}	0.00003559	4	1	1	2
🔵	🔴	🔴	🟢	🔵	🔴	🔴	🔴	1.53389×10^{-9}	0.00007051	5	0	2	1
🔵	🔴	🟠	🟢	🔵	🔴	🔴	🔴	5.58943×10^{-9}	0.00002069	4	1	2	1
🔵	🔴	🔴	🟢	🟢	🔴	🔴	🟠	8.87118×10^{-8}	0.00012128	4	1	1	2
🔵	🔴	🟠	🟢	🟢	🔴	🔴	🟠	3.23262×10^{-7}	0.00003559	3	2	1	2
🔵	🔴	🔴	🟢	🔵	🔴	🔴	🟠	5.58943×10^{-9}	0.00007051	4	1	2	1
🔵	🔴	🟠	🟢	🔵	🔴	🔴	🟠	2.03676×10^{-8}	0.00002069	3	2	2	1
🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	-1.13922×10^{-7}	0.00003047	3.5	1.5	2	1
								9.30216×10^{-6}	0.00137998				

Table 59: The third and fourth values in the initial section are TP or FP

TN	N	TP	P	N	TP	TP	P	p|H0	p|H1	TP	FP	FN	TN
🟢	🟢	🔴	🟠	🟢	🔴	🔴	🔴	1.38732×10^{-7}	0.00006121	4	1	0	3
🟢	🔵	🔴	🔴	🟢	🔴	🔴	🔴	2.39878×10^{-9}	0.00012128	5	0	1	2
🟢	🟢	🔴	🟠	🔵	🔴	🔴	🔴	8.87118×10^{-8}	0.00003559	4	1	1	2
🟢	🔵	🔴	🔴	🔵	🔴	🔴	🔴	1.53389×10^{-9}	0.00007051	5	0	2	1

🟢	🟢	🔴	🟡	🟢	🔴	🔴	🟡	5.05535×10^{-7}	0.00006121	3	2	0	3
🟢	🔵	🔴	🔴	🟢	🔴	🔴	🟡	8.74106×10^{-9}	0.00012128	4	1	1	2
🟢	🟢	🔴	🟡	🔵	🔴	🔴	🟡	3.23262×10^{-7}	0.00003559	3	2	1	2
🟢	🔵	🔴	🔴	🔵	🔴	🔴	🟡	5.58943×10^{-9}	0.00007051	4	1	2	1
🟢	🔵	🔴	🟡	🔵	🔴	🔴	🟡	2.03676×10^{-8}	0.00002069	3	2	2	1
🟢	🟢	🔴	🔴	🔵	🔴	🔴	🟡	8.87118×10^{-8}	0.00012128	4	1	1	2
🟢	🔵	🔴	🟡	🟢	🔴	🔴	🟡	3.18521×10^{-8}	0.00003559	3	2	1	2
🟢	🟢	🔴	🔴	🟢	🔴	🔴	🟡	1.38732×10^{-7}	0.00020862	4	1	0	3
🟢	🔵	🔴	🟡	🔵	🔴	🔴	🔴	5.58943×10^{-9}	0.00002069	4	1	2	1
🟢	🟢	🔴	🔴	🔵	🔴	🔴	🔴	2.43449×10^{-8}	0.00012128	5	0	1	2
🟢	🔵	🔴	🟡	🟢	🔴	🔴	🔴	8.74106×10^{-9}	0.00003559	4	1	1	2
🟢	🟢	🔴	🔴	🟢	🔴	🔴	🔴	3.80719×10^{-8}	0.00020862	5	0	0	3
								1.43092×10^{-6}	0.00134951				

Table 60: The second and fourth values in the initial section are TP or FP

N	P	N	P	N	TP	TP	P	$p\|H_0$	$p\|H_1$	TP	FP	FN	TN
🟢	🔴	🟢	🟡	🟢	🔴	🔴	🔴	1.79704×10^{-8}	0.00001740	4	0	0	3
🔵	🔴	🟢	🟡	🟢	🔴	🔴	🔴	1.79704×10^{-8}	0.00001740	4	0	1	2
🟢	🔴	🟢	🟡	🔵	🔴	🔴	🔴	1.13225×10^{-9}	0.00001011	4	0	1	2
🔵	🔴	🟢	🟡	🔵	🔴	🔴	🔴	1.13225×10^{-9}	0.00001011	4	0	2	1
🟢	🔴	🟢	🟡	🟢	🔴	🔴	🟡	6.54833×10^{-8}	0.00001740	3	1	0	3
🔵	🔴	🟢	🟡	🟢	🔴	🔴	🟡	6.54833×10^{-8}	0.00001740	3	1	1	2
🟢	🔴	🟢	🟡	🔵	🔴	🔴	🟡	4.12588×10^{-9}	0.00001011	3	1	1	2
🔵	🔴	🟢	🟡	🔵	🔴	🔴	🟡	4.12588×10^{-9}	0.00001011	3	1	2	1
🟢	🔴	🟢	🔴	🟢	🔴	🔴	🔴	1.79704×10^{-8}	0.00001740	5	0	0	3
🔵	🔴	🟢	🔴	🟢	🔴	🔴	🔴	1.79704×10^{-8}	0.00001740	5	0	1	2
🟢	🔴	🟢	🔴	🔵	🔴	🔴	🔴	1.13225×10^{-9}	0.00001011	5	0	1	2
🔵	🔴	🟢	🔴	🔵	🔴	🔴	🔴	1.13225×10^{-9}	0.00001011	5	0	2	1
🟢	🔴	🟢	🔴	🟢	🔴	🔴	🟡	6.54833×10^{-8}	0.00001740	4	0	0	3
🔵	🔴	🟢	🔴	🟢	🔴	🔴	🟡	6.54833×10^{-8}	0.00001740	4	0	1	2
🟢	🔴	🟢	🔴	🔵	🔴	🔴	🟡	4.12588×10^{-9}	0.00001011	4	0	1	2
🔵	🔴	🟢	🔴	🔵	🔴	🔴	🟡	4.12588×10^{-9}	0.00001011	4	0	2	1
🔵	🔴	🔵	🟡	🟢	🔴	🔴	🔴	1.79704×10^{-8}	0.00001740	4	0	2	1
🟢	🔴	🔵	🟡	🟢	🔴	🔴	🔴	1.79704×10^{-8}	0.00001740	4	0	1	2
🔵	🔴	🔵	🟡	🔵	🔴	🔴	🔴	1.13225×10^{-9}	0.00001011	4	0	3	0
🟢	🔴	🔵	🟡	🔵	🔴	🔴	🔴	1.13225×10^{-9}	0.00001011	4	0	2	1
🔵	🔴	🔵	🟡	🟢	🔴	🔴	🟡	6.54833×10^{-8}	0.00001740	3	1	2	1
🟢	🔴	🔵	🟡	🟢	🔴	🔴	🟡	6.54833×10^{-8}	0.00001740	3	1	1	2
🔵	🔴	🔵	🟡	🔵	🔴	🔴	🟡	4.12588×10^{-9}	0.00001011	3	1	3	0
🟢	🔴	🔵	🟡	🔵	🔴	🔴	🟡	4.12588×10^{-9}	0.00001011	3	1	2	1
🔵	🔴	🔵	🔴	🟢	🔴	🔴	🔴	1.79704×10^{-8}	0.00001740	5	0	2	1
🟢	🔴	🔵	🔴	🟢	🔴	🔴	🔴	1.79704×10^{-8}	0.00001740	5	0	1	2

🔵	🔴	🔵	🔴	🔵	🔴	🔴	🔴	1.13225×10^{-9}	0.00001011	5	0	3	0
🟢	🔴	🔵	🔴	🔵	🔴	🔴	🔴	1.13225×10^{-9}	0.00001011	5	0	2	1
🔵	🔴	🔵	🔴	🟢	🔴	🔴	🟡	6.54833×10^{-8}	0.00001740	4	0	2	1
🟢	🔴	🔵	🔴	🟢	🔴	🔴	🟡	6.54833×10^{-8}	0.00001740	4	0	1	2
🔵	🔴	🔵	🔴	🔵	🔴	🔴	🟡	4.12588×10^{-9}	0.00001011	4	0	3	0
🟢	🔴	🔵	🔴	🔵	🔴	🔴	🟡	4.12588×10^{-9}	0.00001011	4	0	2	1
🟢	🟡	🔵	🔴	🟢	🔴	🔴	🔴	4.93156×10^{-9}	0.00005930	4	0	1	2
🔵	🟡	🔵	🔴	🟢	🔴	🔴	🔴	6.54833×10^{-8}	0.00000511	4	0	2	1
🟢	🟡	🔵	🔴	🔵	🔴	🔴	🔴	3.10721×10^{-10}	0.00003447	4	0	2	1
🔵	🟡	🔵	🔴	🔵	🔴	🔴	🔴	4.12588×10^{-9}	0.00000297	4	0	3	0
🟢	🟡	🔵	🔴	🟢	🔴	🔴	🟡	1.79704×10^{-8}	0.00005930	3	1	1	2
🔵	🟡	🔵	🔴	🟢	🔴	🔴	🟡	2.38618×10^{-7}	0.00000511	3	1	2	1
🟢	🟡	🔵	🔴	🔵	🔴	🔴	🟡	1.13225×10^{-9}	0.00003447	3	1	2	1
🔵	🟡	🔵	🔴	🔵	🔴	🔴	🟡	1.50345×10^{-8}	0.00000297	3	1	3	0
🟢	🟡	🔵	🟡	🟢	🔴	🔴	🔴	4.93156×10^{-9}	0.00005930	3	1	1	2
🔵	🟡	🔵	🟡	🟢	🔴	🔴	🔴	6.54833×10^{-8}	0.00000511	3	1	2	1
🟢	🟡	🔵	🟡	🔵	🔴	🔴	🔴	3.10721×10^{-10}	0.00003447	3	1	2	1
🔵	🟡	🔵	🟡	🔵	🔴	🔴	🔴	4.12588×10^{-9}	0.00000297	3	1	3	0
🟢	🟡	🔵	🟡	🟢	🔴	🔴	🟡	1.79704×10^{-8}	0.00005930	2	2	1	2
🔵	🟡	🔵	🟡	🟢	🔴	🔴	🟡	2.38618×10^{-7}	0.00000511	2	2	2	1
🟢	🟡	🔵	🟡	🔵	🔴	🔴	🟡	1.13225×10^{-9}	0.00003447	2	2	2	1
🔵	🟡	🔵	🟡	🔵	🔴	🔴	🟡	1.50345×10^{-8}	0.00000297	2	2	3	0
🔵	🟡	🟢	🔴	🟢	🔴	🔴	🔴	4.93156×10^{-9}	0.00005930	4	0	1	2
🟢	🟡	🟢	🔴	🟢	🔴	🔴	🔴	6.54833×10^{-8}	0.00000511	4	0	0	3
🔵	🟡	🟢	🔴	🔵	🔴	🔴	🔴	3.10721×10^{-10}	0.00003447	4	0	2	1
🟢	🟡	🟢	🔴	🔵	🔴	🔴	🔴	4.12588×10^{-9}	0.00000297	4	0	1	2
🔵	🟡	🟢	🔴	🟢	🔴	🔴	🟡	1.79704×10^{-8}	0.00005930	3	1	1	2
🟢	🟡	🟢	🔴	🟢	🔴	🔴	🟡	2.38618×10^{-7}	0.00000511	3	1	0	3
🔵	🟡	🟢	🔴	🔵	🔴	🔴	🟡	1.13225×10^{-9}	0.00003447	3	1	2	1
🟢	🟡	🟢	🔴	🔵	🔴	🔴	🟡	1.50345×10^{-8}	0.00000297	3	1	1	2
🔵	🟡	🟢	🟡	🟢	🔴	🔴	🔴	4.93156×10^{-9}	0.00005930	3	1	1	2
🟢	🟡	🟢	🟡	🟢	🔴	🔴	🔴	6.54833×10^{-8}	0.00000511	3	1	0	3
🔵	🟡	🟢	🟡	🔵	🔴	🔴	🔴	3.10721×10^{-10}	0.00003447	3	1	2	1
🟢	🟡	🟢	🟡	🔵	🔴	🔴	🔴	4.12588×10^{-9}	0.00000297	3	1	1	2
🔵	🟡	🟢	🟡	🟢	🔴	🔴	🟡	1.79704×10^{-8}	0.00005930	2	2	1	2
🟢	🟡	🟢	🟡	🟢	🔴	🔴	🟡	2.38618×10^{-7}	0.00000511	2	2	0	3
🔵	🟡	🟢	🟡	🔵	🔴	🔴	🟡	1.13225×10^{-9}	0.00003447	2	2	2	1
🟢	🟡	🟢	🟡	🔵	🔴	🔴	🟡	2.83617×10^{-7}	0.00000297	2	2	1	2
								2.3687×10^{-6}	0.00125493				

Patterns and probabilities of suspect 8-ary patterns with three P in the initial section

Table 61 displays the thirty-two possible patterns when the first, second and fourth observations are P (TP or FP), the probability of each sequence pattern, and the count of TP, FP, FN and TN.

Table 62 displays the thirty-two possible patterns when the first, third and fourth observations are P (TP or FP), the probability of each sequence pattern, and the count of TP, FP, FN and TN.

Table 61: The first, second and fourth values in the initial section are TP or FP

TP	P	N	P	N	TP	TP	P	p | H_0	p | H_1	TP	FP	FN	TN
🔴	🔴	🟢	🟡	🟢	🔴	🔴	🔴	3.58153×10^{-8}	0.00040063	5	1	0	2
🔴	🔴	🔵	🟡	🟢	🔴	🔴	🔴	2.25660×10^{-9}	0.00023290	5	1	1	1
🔴	🔴	🟢	🟡	🔵	🔴	🔴	🔴	2.25660×10^{-9}	0.00023290	5	1	1	1
🔴	🔴	🔵	🟡	🔵	🔴	🔴	🔴	1.42181×10^{-10}	0.00013540	5	1	2	0
🔴	🔴	🟢	🟡	🟢	🔴	🔴	🟡	1.30509×10^{-7}	0.00040063	4	2	0	2
🔴	🔴	🔵	🟡	🟢	🔴	🔴	🟡	8.22296×10^{-9}	0.00023290	4	2	1	1
🔴	🔴	🟢	🟡	🔵	🔴	🔴	🟡	8.22296×10^{-9}	0.000232290	4	2	1	1
🔴	🔴	🔵	🟡	🔵	🔴	🔴	🟡	5.18101×10^{-10}	0.00013540	4	2	2	0
🔴	🔴	🟢	🔴	🟢	🔴	🔴	🔴	9.82869×10^{-9}	0.00136536	6	0	0	2
🔴	🔴	🔵	🔴	🟢	🔴	🔴	🔴	6.19273×10^{-10}	0.00079375	6	0	1	1
🔴	🔴	🟢	🔴	🔵	🔴	🔴	🔴	6.19273×10^{-10}	0.00079375	6	0	1	1
🔴	🔴	🔵	🔴	🔵	🔴	🔴	🔴	3.90183×10^{-11}	0.00046145	6	0	2	0
🔴	🔴	🟢	🔴	🟢	🔴	🔴	🟡	3.58153×10^{-8}	0.00136536	5	1	0	2
🔴	🔴	🔵	🔴	🟢	🔴	🔴	🟡	2.25660×10^{-9}	0.00079375	5	1	1	1
🔴	🔴	🟢	🔴	🔵	🔴	🔴	🟡	2.25660×10^{-9}	0.00079375	5	1	1	1
🔴	🔴	🔵	🔴	🔵	🔴	🔴	🟡	1.42181×10^{-10}	0.00046145	5	1	2	0
🔴	🟡	🔵	🔴	🟢	🔴	🔴	🔴	2.25660×10^{-9}	0.00023290	5	1	1	1
🔴	🟡	🟢	🔴	🟢	🔴	🔴	🔴	3.58153×10^{-8}	0.00040063	5	1	0	2
🔴	🟡	🔵	🔴	🔵	🔴	🔴	🔴	1.42181×10^{-10}	0.00013540	5	1	2	0
🔴	🟡	🟢	🔴	🔵	🔴	🔴	🔴	2.25660×10^{-9}	0.00023290	5	1	1	1
🔴	🟡	🔵	🔴	🟢	🔴	🔴	🟡	8.22296×10^{-9}	0.00023290	4	2	1	1
🔴	🟡	🟢	🔴	🟢	🔴	🔴	🟡	1.30509×10^{-7}	0.000401063	4	2	0	2
🔴	🟡	🔵	🔴	🔵	🔴	🔴	🟡	5.18101×10^{-10}	0.000135	4	2	2	0
🔴	🟡	🟢	🔴	🔵	🔴	🔴	🟡	8.22296×10^{-9}	0.00023290	4	2	1	1
🔴	🟡	🔵	🟡	🟢	🔴	🔴	🔴	8.22296×10^{-9}	0.00006834	4	2	1	1
🔴	🟡	🟢	🟡	🟢	🔴	🔴	🔴	1.30509×10^{-7}	0.00011755	4	2	0	2
🔴	🟡	🔵	🟡	🔵	🔴	🔴	🔴	5.18101×10^{-10}	0.00003973	4	2	2	0
🔴	🟡	🟢	🟡	🔵	🔴	🔴	🔴	8.22296×10^{-9}	0.00006834	4	2	1	1
🔴	🟡	🔵	🟡	🟢	🔴	🔴	🟡	2.99641×10^{-8}	0.00006834	3	3	1	1
🔴	🟡	🟢	🟡	🟢	🔴	🔴	🟡	4.75571×10^{-7}	0.00011755	3	3	0	2
🔴	🟡	🔵	🟡	🔵	🔴	🔴	🟡	1.88794×10^{-9}	0.00003973	3	3	2	0
🔴	🟡	🟢	🟡	🔵	🔴	🔴	🟡	2.99641×10^{-8}	0.00006834	3	3	1	1
								0.00007971	0.01142389				

Table 62: The first, third and fourth values in the initial section are TP or FP

TP	P	N	P	N	TP	TP	P	p|H0	p|H1	TP	FP	FN	TN
🔴	🟢	🔴	🟡	🟢	🔴	🔴	🔴	1.57430×10^{-6}	0.00044795	5	1	0	2
🟡	🔵	🔴	🟡	🟢	🔴	🔴	🔴	9.91913×10^{-8}	0.00007641	4	2	1	1
🔴	🟢	🔴	🟡	🔵	🔴	🔴	🔴	9.91913×10^{-8}	0.00026042	5	1	1	1
🟡	🔵	🔴	🟡	🔵	🔴	🔴	🔴	6.24971×10^{-9}	0.000044795	4	2	2	0
🔴	🟢	🔴	🟡	🟢	🔴	🔴	🟡	5.73668×10^{-6}	0.00044795	4	2	0	2
🟡	🔵	🔴	🟡	🟢	🔴	🔴	🟡	3.61449×10^{-7}	0.00007641	3	3	1	1
🔴	🟢	🔴	🟡	🔵	🔴	🔴	🟡	3.61449×10^{-7}	0.00026042	4	2	1	1
🟡	🔵	🔴	🟡	🔵	🔴	🔴	🟡	2.27737×10^{-8}	0.00004442	3	3	2	0
🔴	🟢	🔴	🔴	🟢	🔴	🔴	🔴	4.32030×10^{-7}	0.00152665	6	0	0	2
🟡	🔵	🔴	🔴	🟢	🔴	🔴	🔴	2.72208×10^{-8}	0.00026042	5	1	1	1
🔴	🟢	🔴	🔴	🔵	🔴	🔴	🔴	2.72208×10^{-8}	0.00088752	6	0	1	1
🟡	🔵	🔴	🔴	🔵	🔴	🔴	🔴	1.71509×10^{-9}	0.00015139	5	1	2	0
🔴	🟢	🔴	🔴	🟢	🔴	🔴	🟡	1.57430×10^{-6}	0.00152665	5	1	0	2
🟡	🔵	🔴	🔴	🟢	🔴	🔴	🟡	9.91913×10^{-8}	0.00026042	4	2	1	1
🔴	🟢	🔴	🔴	🔵	🔴	🔴	🟡	9.91913×10^{-8}	0.00088752	5	1	1	1
🟡	🔵	🔴	🔴	🔵	🔴	🔴	🟡	6.24971×10^{-9}	0.00015139	4	2	2	0
🔴	🔵	🔴	🔴	🟢	🔴	🔴	🔴	2.72208×10^{-8}	0.00088752	6	0	1	1
🟡	🟢	🔴	🔴	🟢	🔴	🔴	🔴	4.32030×10^{-7}	0.00044795	5	1	0	2
🔴	🔵	🔴	🔴	🔵	🔴	🔴	🔴	1.71509×10^{-9}	0.00051596	6	0	2	0
🟡	🟢	🔴	🔴	🔵	🔴	🔴	🔴	2.72208×10^{-8}	0.00026042	5	1	1	1
🔴	🔵	🔴	🔴	🟢	🔴	🔴	🟡	9.91913×10^{-8}	0.00088752	5	1	1	1
🟡	🟢	🔴	🔴	🟢	🔴	🔴	🟡	1.57430×10^{-6}	0.00044795	4	2	0	2
🔴	🔵	🔴	🔴	🔵	🔴	🔴	🟡	6.24971×10^{-9}	0.00051596	5	1	2	0
🟡	🟢	🔴	🔴	🔵	🔴	🔴	🟡	9.91913×10^{-8}	0.00026042	4	2	1	1
🔴	🔵	🔴	🟡	🟢	🔴	🔴	🔴	9.91913×10^{-8}	0.00026042	5	1	1	1
🟡	🟢	🔴	🟡	🟢	🔴	🔴	🔴	1.57430×10^{-6}	0.00013144	4	2	0	2
🔴	🔵	🔴	🟡	🔵	🔴	🔴	🔴	6.24971×10^{-9}	0.00015139	5	1	2	0
🟡	🟢	🔴	🟡	🔵	🔴	🔴	🔴	9.91913×10^{-8}	0.00007641	4	2	1	1
🔴	🔵	🔴	🟡	🟢	🔴	🔴	🟡	3.61449×10^{-7}	0.00026042	4	2	1	1
🟡	🟢	🔴	🟡	🟢	🔴	🔴	🟡	5.73668×10^{-6}	0.00013144	3	3	0	2
🔴	🔵	🔴	🟡	🔵	🔴	🔴	🟡	2.27737×10^{-8}	0.00015139	4	2	2	0
🟡	🟢	🔴	🟡	🔵	🔴	🔴	🟡	3.61449×10^{-7}	0.00007641	3	3	1	1
								2.10568×10^{-5}	0.01277340				