Report of Entropy estimates based on NIST SP 800-90B non-IID track

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1 Identification information

1.1 Identification of acquisition data from entropy source

Table 1 Identification information of acquisition data from entropy source

URL of the acquisition data	`https://github.com/usnistgov/SP800-90B_EntropyAssessment/blob/master/bin/rand1_short.bin`

- Name of the submitter of the acquisition data :
- Brief explanation of the acquisition data (or entropy source) :

1.2 Identification of analysis environment

Table 2 Identification information of analysis environment

Analysis tool	Name	Another entropy estimation tool with extensions
	Versioning information	1.0.43
Analysis environment	Hostname	[redacted]
	CPU information	AMD Ryzen [redacted]
	Physical memory size	[redacted] MB
	OS information	Windows 10 or greater
	Username	[redacted]

1.3 Identification of analysis conditions

Table 3 Identification information of analysis conditions

Number of samples	10000
Bits per sample	1

1.4 Identification of analysis method

NIST SP 800-90B [1] 6.3 with corrections [2] is applied

2 Executive summary

2.1 Numerical results of min-entropy estimates based on non-IID track

Table 4 Numerical results

Estimator	$H_{\text{bitstring}}$ [a] [bit / 1 - bit]
The Most Common Value Estimate	0.961059
The Collision Estimate	0.691464
The Markov Estimate	0.987596
The Compression Estimate	0.611716
The t-Tuple Estimate	0.867624
The Longest Repeated Substring (LRS) Estimate	0.962626
Multi Most Common in Window Prediction Estimate	0.952618
The Lag Prediction Estimate	0.943334
The MultiMMC Prediction Estimate	0.961617
The LZ78Y Prediction Estimate	0.961446
The intial entropy source estimate [bit / 1 -bit] $H_I = H_{\text{bitstring}}$	0.611716

[a] Entropy estimate of the sequential dataset [source: NIST SP 800-90B [1] 3.1.3]

2.2 Visual comparison of min-entropy estimates from binary samples

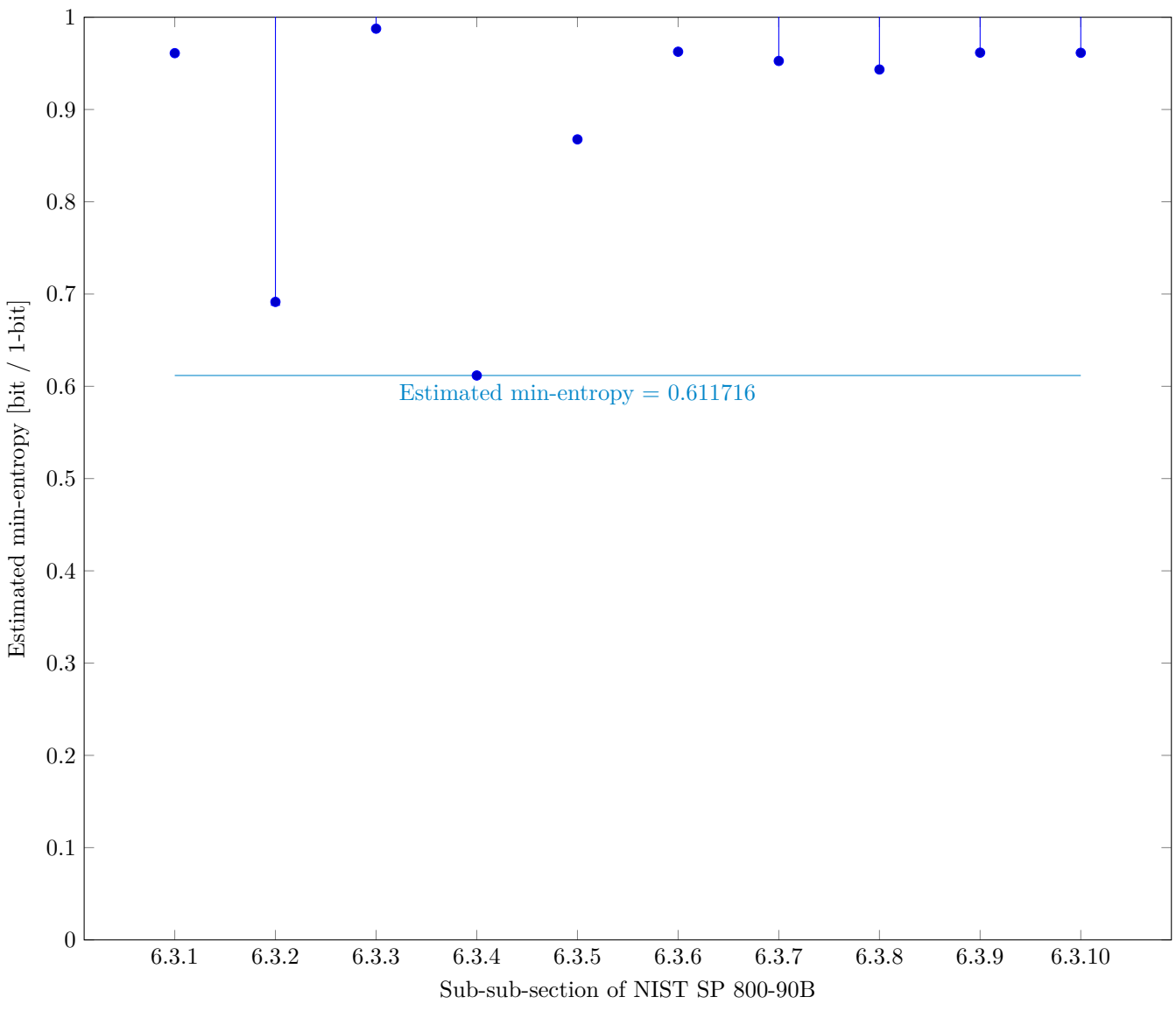
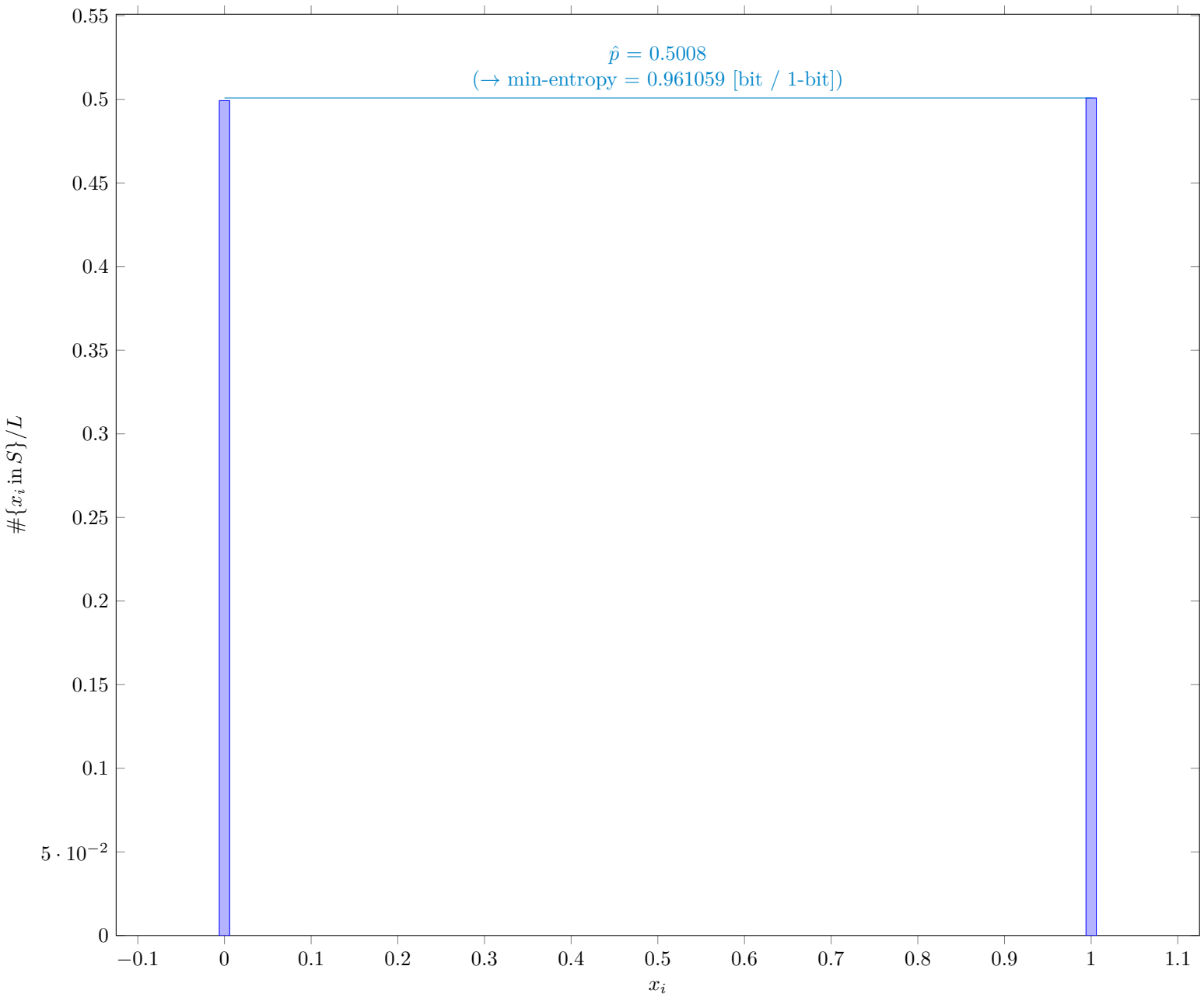


Fig. 1 Estimated Min-Entropy using §6.3 of NIST SP 800-90B

3 Detailed results of analysis from original samples

3.1 The Most Common Value Estimate (NIST SP 800-90B Section 6.3.1)

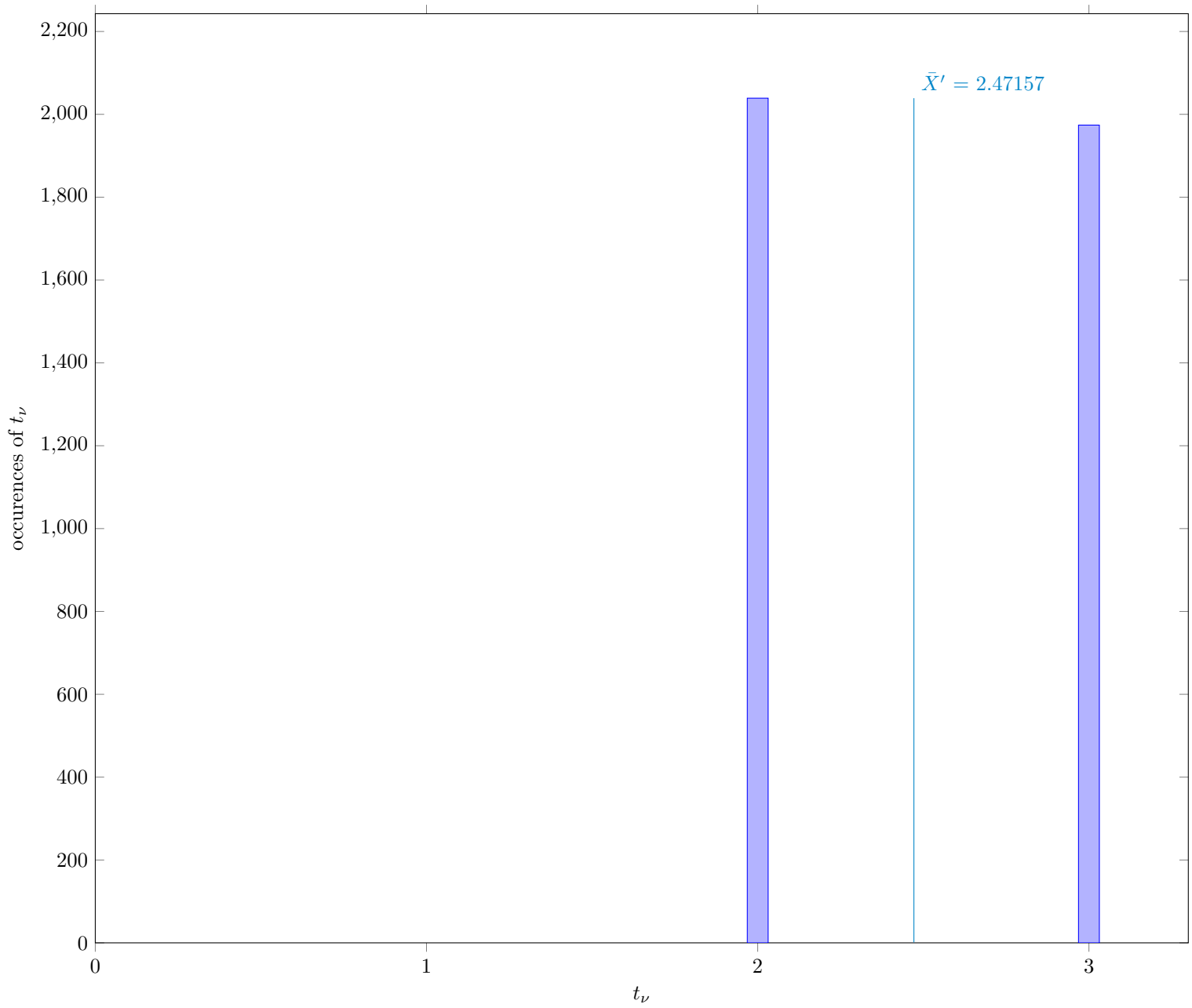


3.1.1 Supplemental information for traceability

Table 5 Supplemental information for traceability (NIST SP 800-90B Section 6.3.1)

Symbol	Value
mode	5008
$\hat{p}$	0.5008
p_u	0.51368

3.2 The Collision Estimate (NIST SP 800-90B Section 6.3.2)



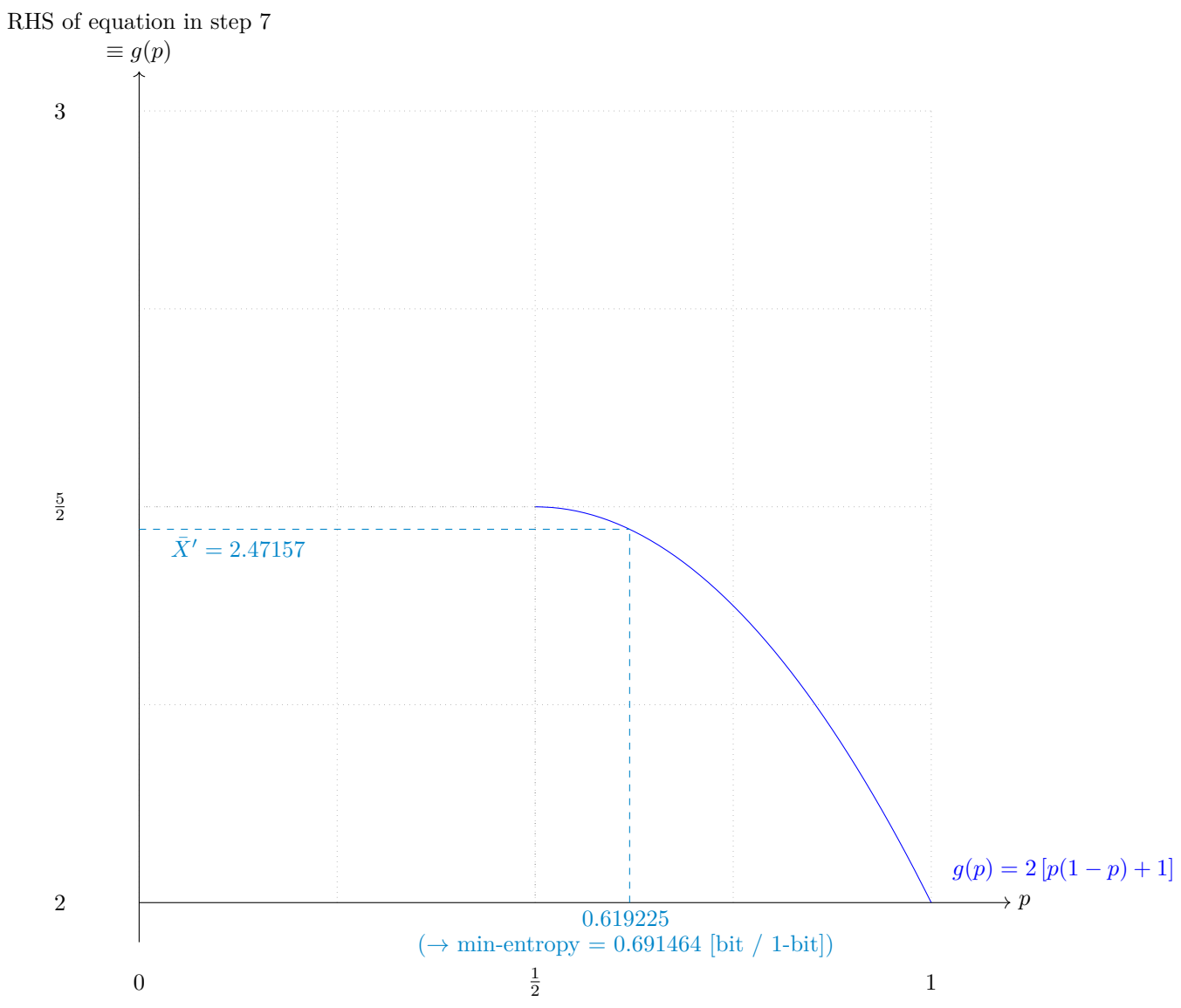


Fig. 2 Solution to the equation in step 7

3.2.1 Supplemental information for traceability

Table 6 Supplemental information for traceability (NIST SP 800-90B Section 6.3.2)

Symbol	Value
p	0.619225
$\bar{X}$	2.4919
$\bar{X}'$	2.47157
$\hat{\sigma}$	0.499997

3.3 The Markov Estimate (NIST SP 800-90B Section 6.3.3)

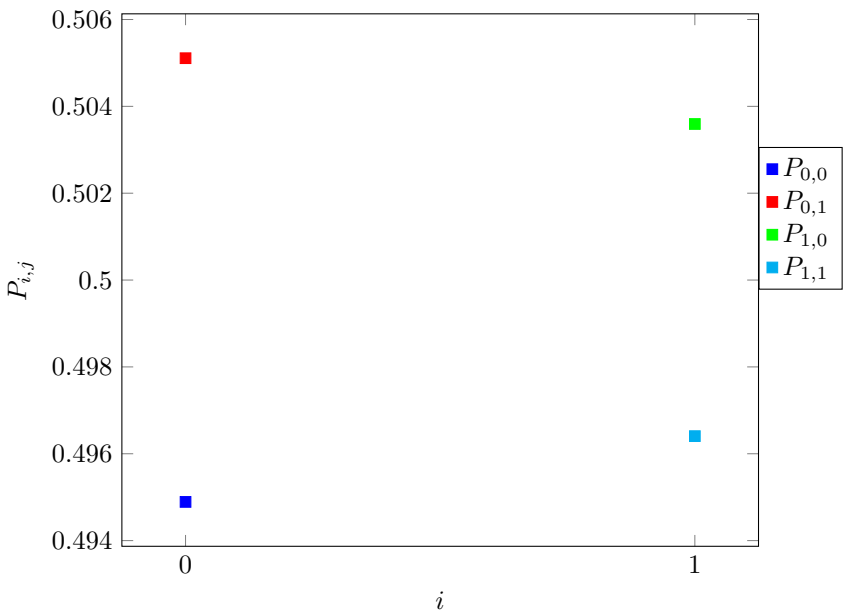


Fig. 3 Transition probability $P_{i,j}$ of §6.3.3 of NIST SP 800-90B

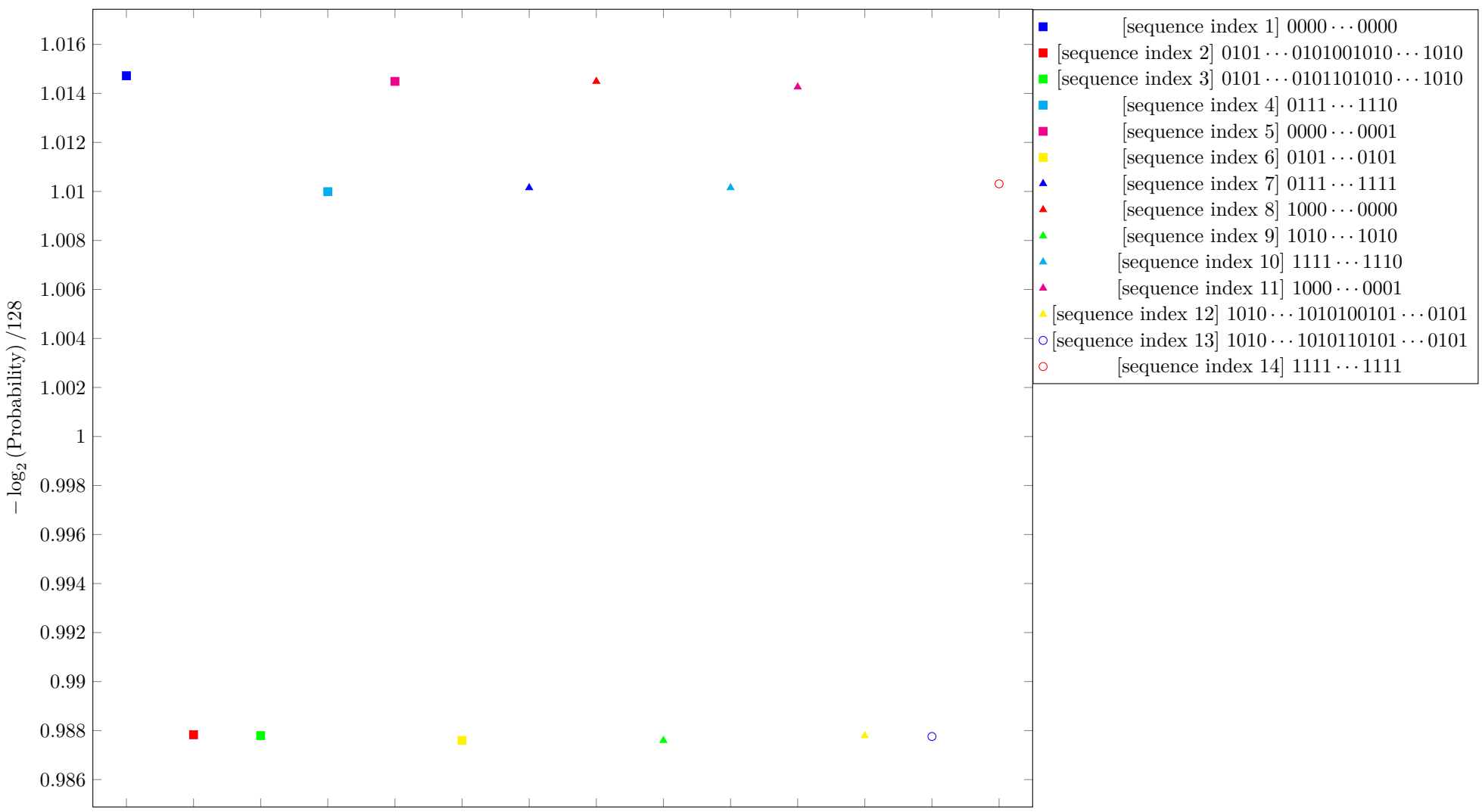
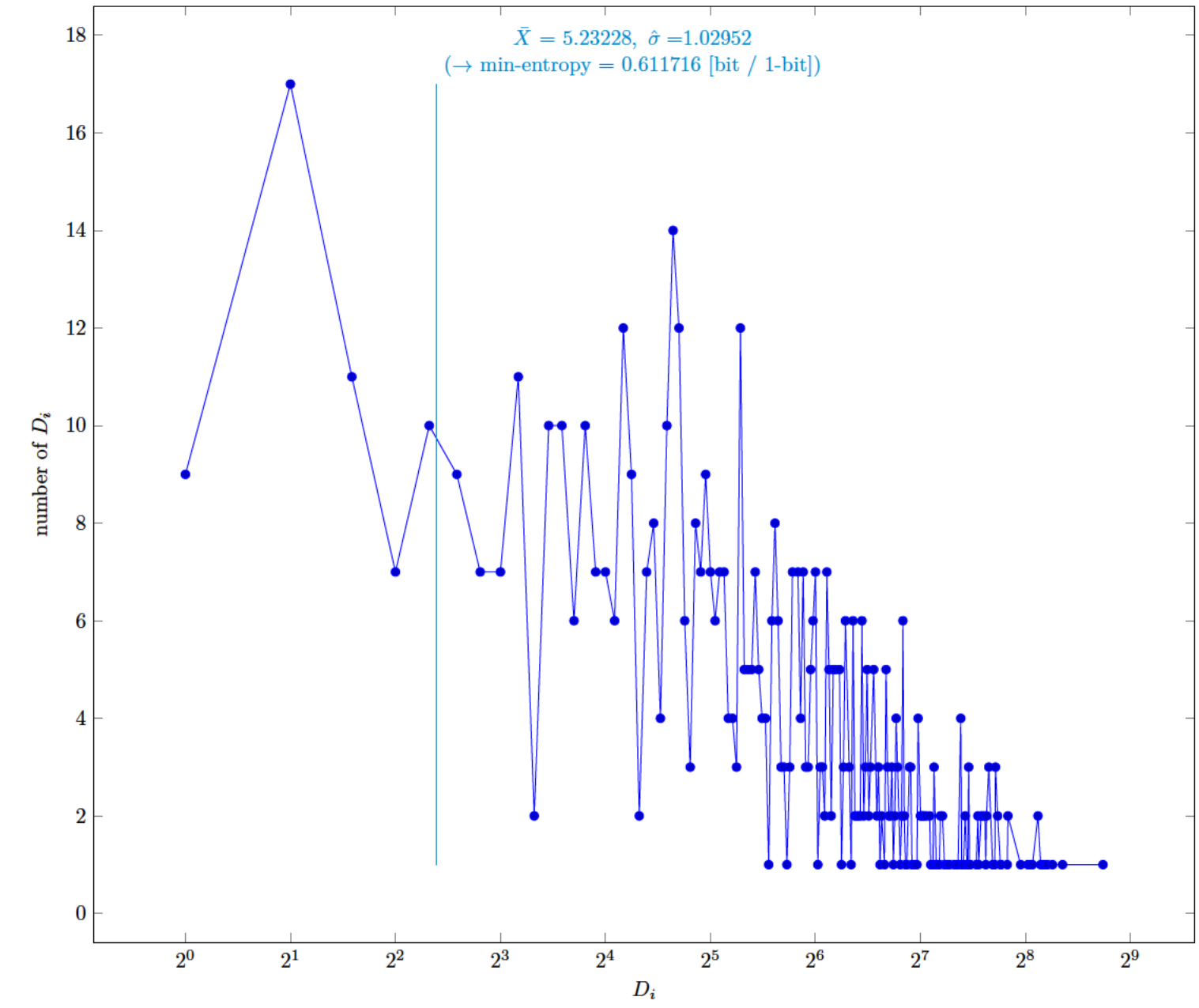


Fig. 4 Estimated Min-Entropy using §6.3.3 of NIST SP 800-90B

3.4 The Compression Estimate (NIST SP 800-90B Section 6.3.4)



3.4.1 Supplemental information for traceability

Table 7 Supplemental information for traceability (NIST SP 800-90B Section 6.3.4)

Symbol	Value
p	0.0785472
$\bar{X}$	5.23228
$\hat{\sigma}$	1.02952
$\bar{X}'$	5.12953

3.5 The t-tuple Estimate (NIST SP 800-90B Section 6.3.5)

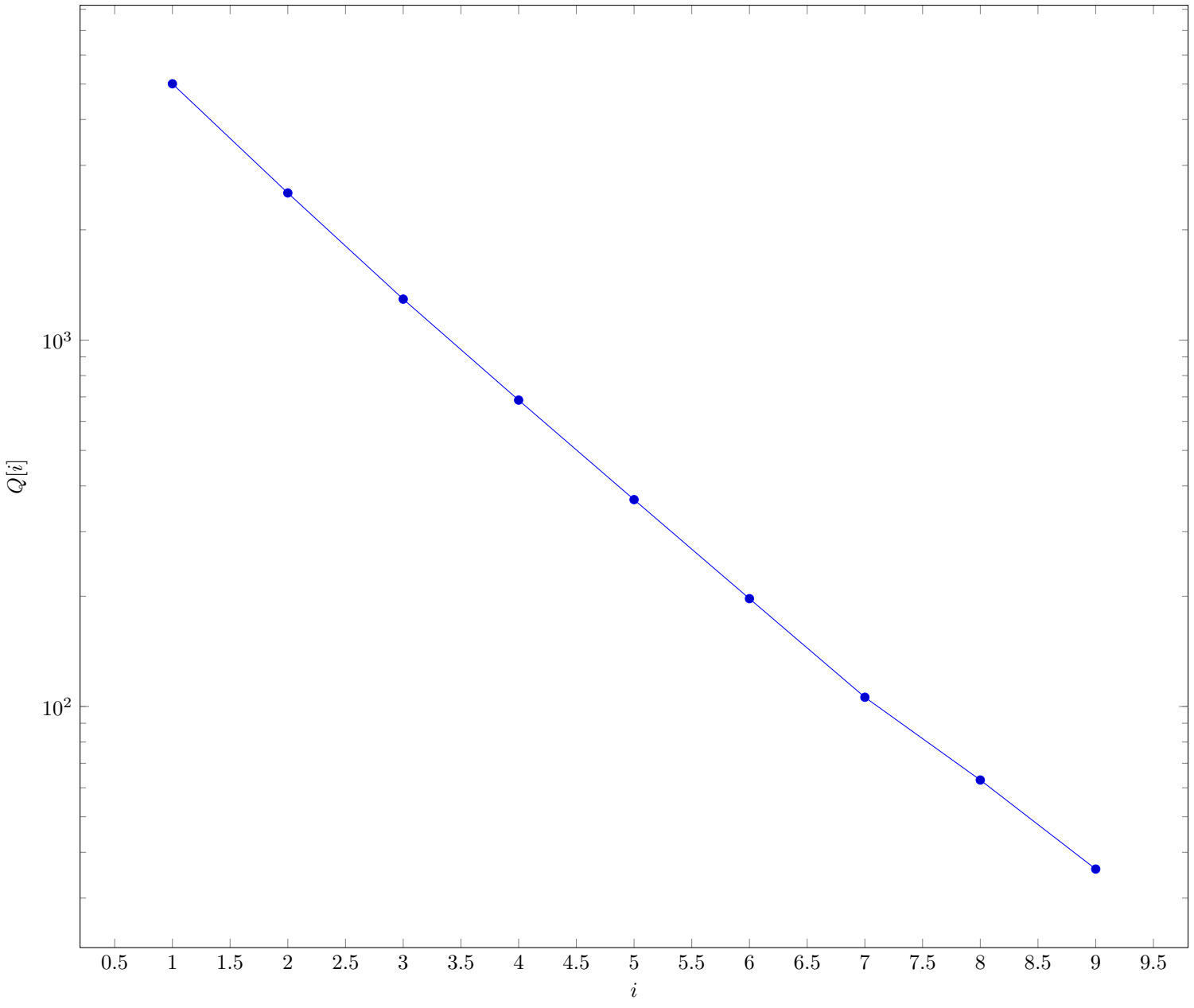


Fig. 5 Intermediate value $Q[i]$ in §6.3.5 of NIST SP 800-90B

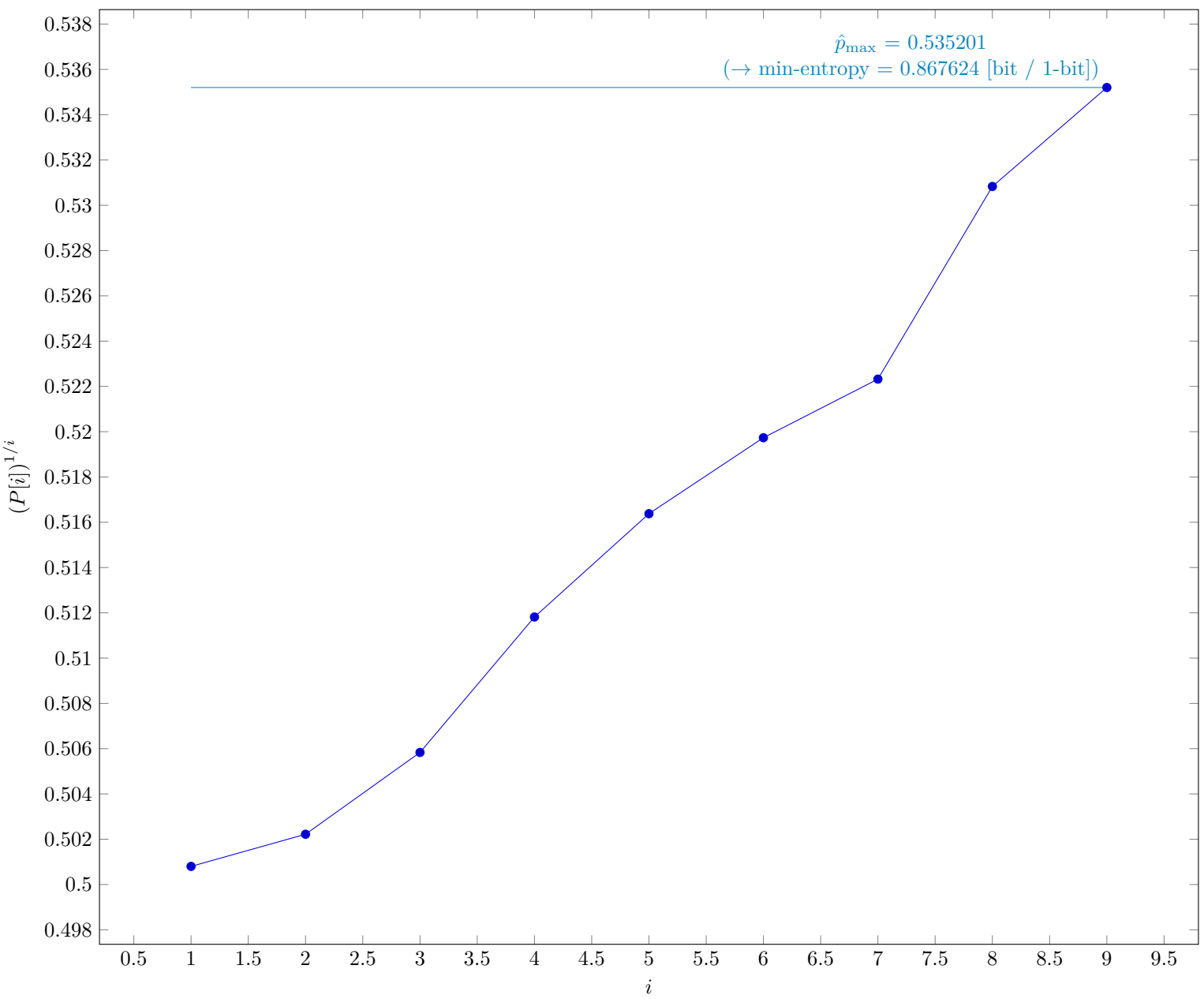


Fig. 6 $P[i]^{1/i}$ in §6.3.5 of NIST SP 800-90B

3.5.1 Supplemental information for traceability

Table 8 Supplemental information for traceability (NIST SP 800-90B Section 6.3.5)

Symbol	Value
t	9
$\hat{p}_{\max}$	0.535201
p_u	0.548049

3.6 The LRS Estimate (NIST SP 800-90B Section 6.3.6)

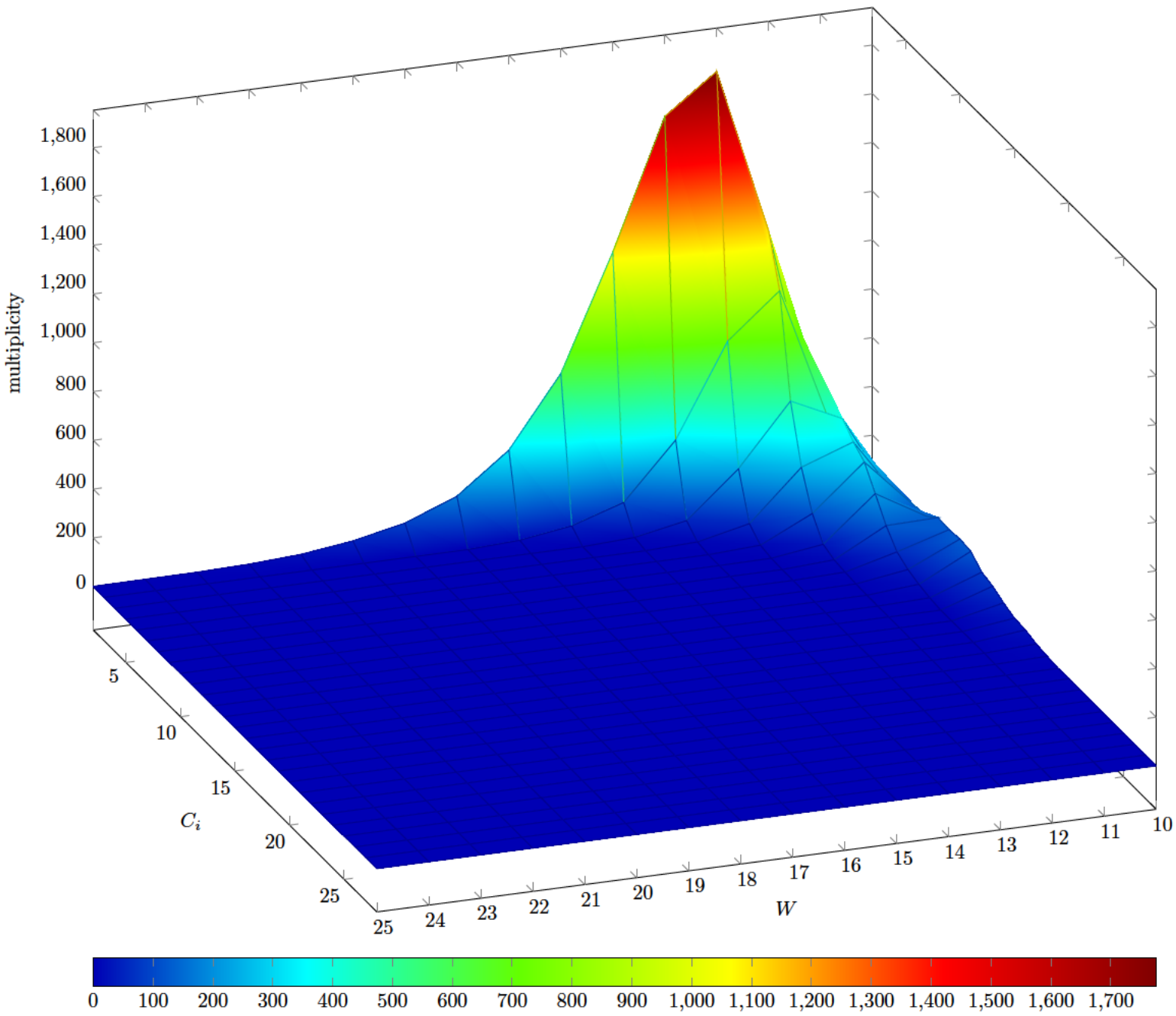


Fig. 7 Estimated W-tuple collision probability in Step 3 of §6.3.6 of NIST SP 800-90B

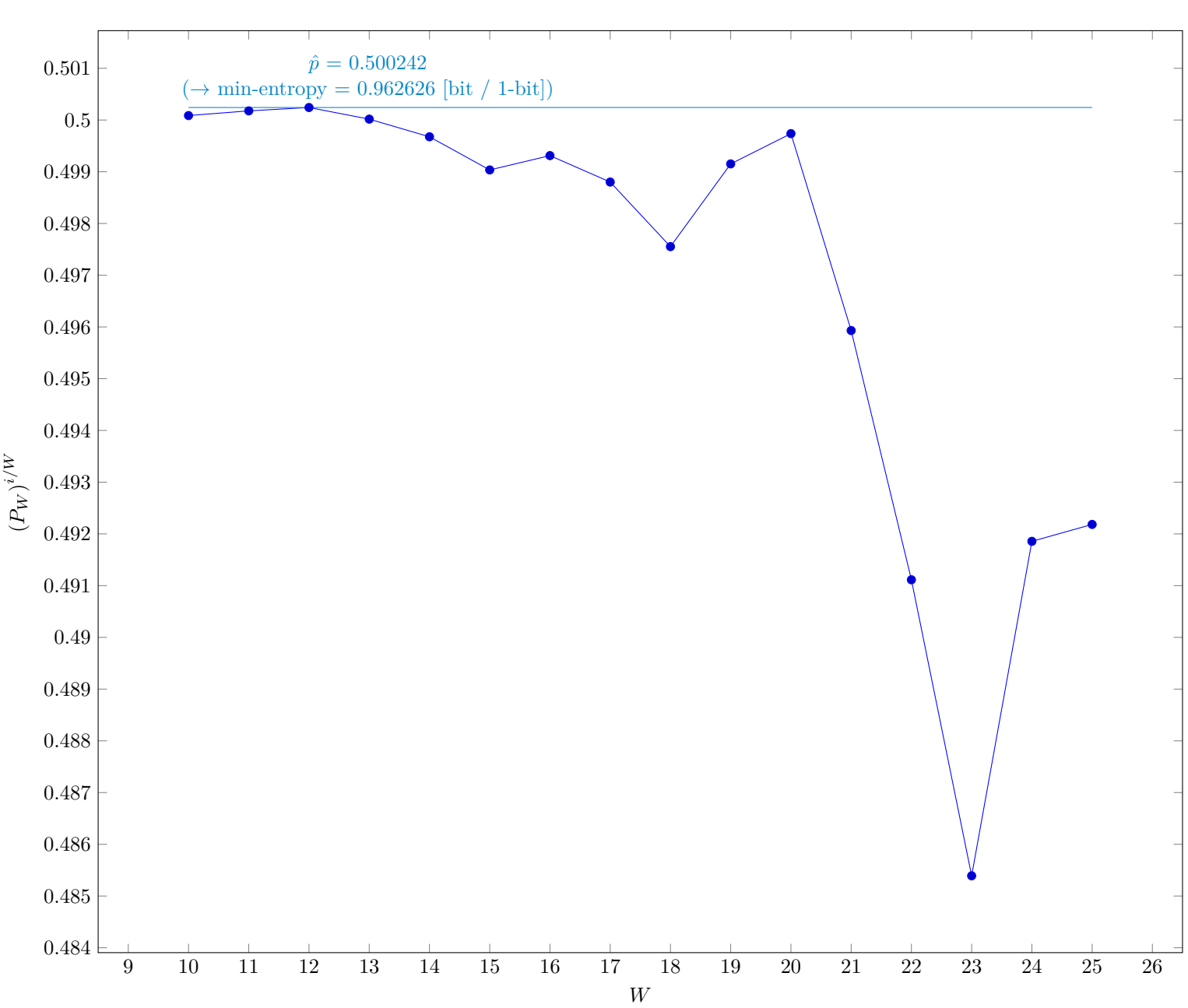


Fig. 8 Estimated average collision probability per string symbol in Step 3 of §6.3.6 of NIST SP 800-90B

3.6.1 Supplemental information for traceability

Table 9 Supplemental information for traceability (NIST SP 800-90B Section 6.3.6)

Symbol	Value
u	10
v	25
$\hat{p}$	0.500242
p_u	0.513122

3.7 Multi Most Common in Window Prediction Estimate (NIST SP 800-90B Section 6.3.7)

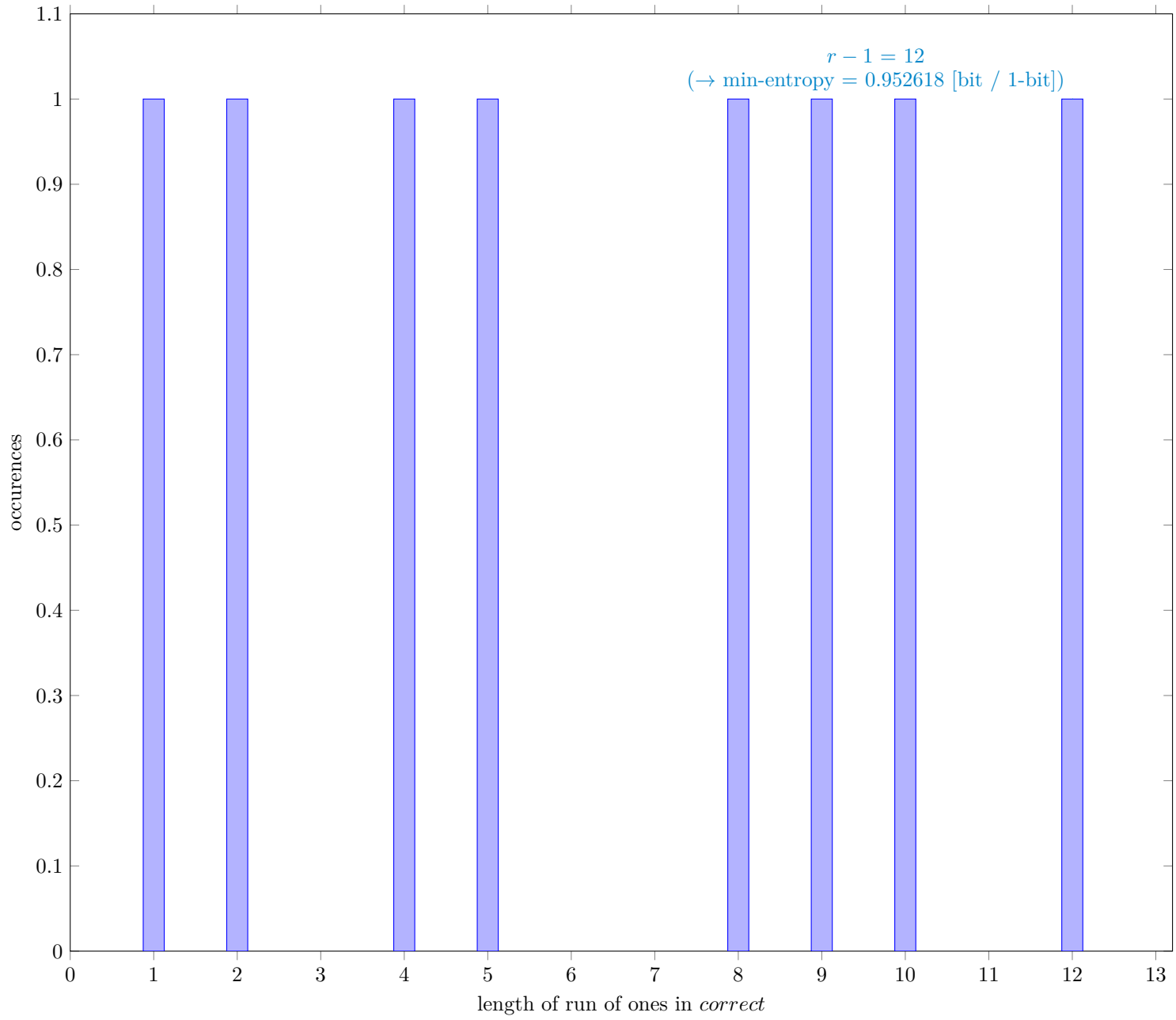


Fig. 9 Distribution of *correct*

3.7.1 Supplemental information for traceability

Table 10 Supplemental information for traceability (NIST SP 800-90B Section 6.3.7)

Symbol	Value
N	9937
C	5006
P_{global}	0.503774
P'_{global}	0.516694
r	13
P_{local}	0.357828

3.8 Lag Prediction Estimate (NIST SP 800-90B Section 6.3.8)

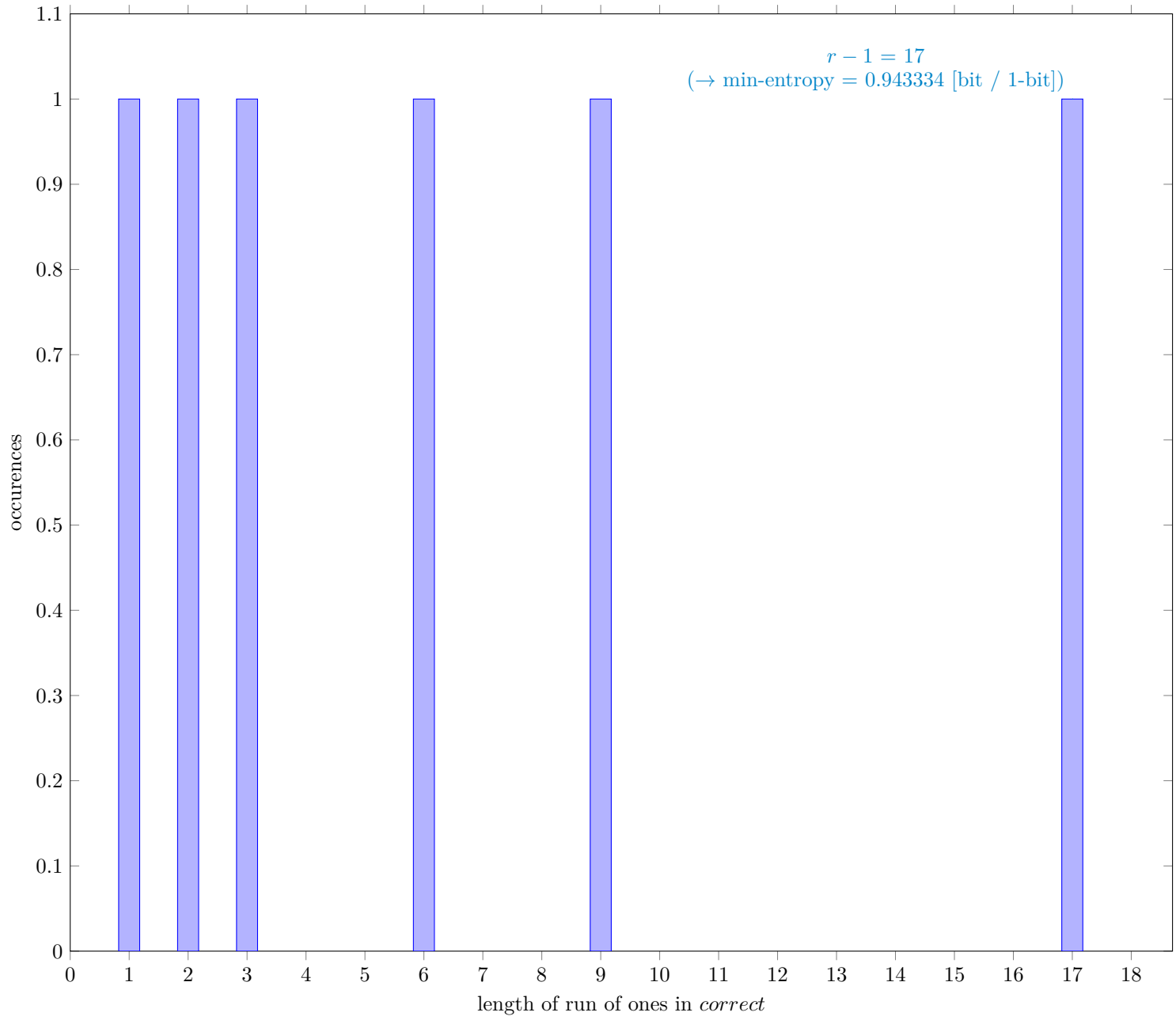


Fig. 10 Distribution of *correct*

3.8.1 Supplemental information for traceability

Table 11 Supplemental information for traceability (NIST SP 800-90B Section 6.3.8)

Symbol	Value
N	9999
C	5071
P_{global}	0.507151
P'_{global}	0.52003
r	18
P_{local}	0.481593

3.9 The MultiMMC Prediction Estimate (NIST SP 800-90B Section 6.3.9)

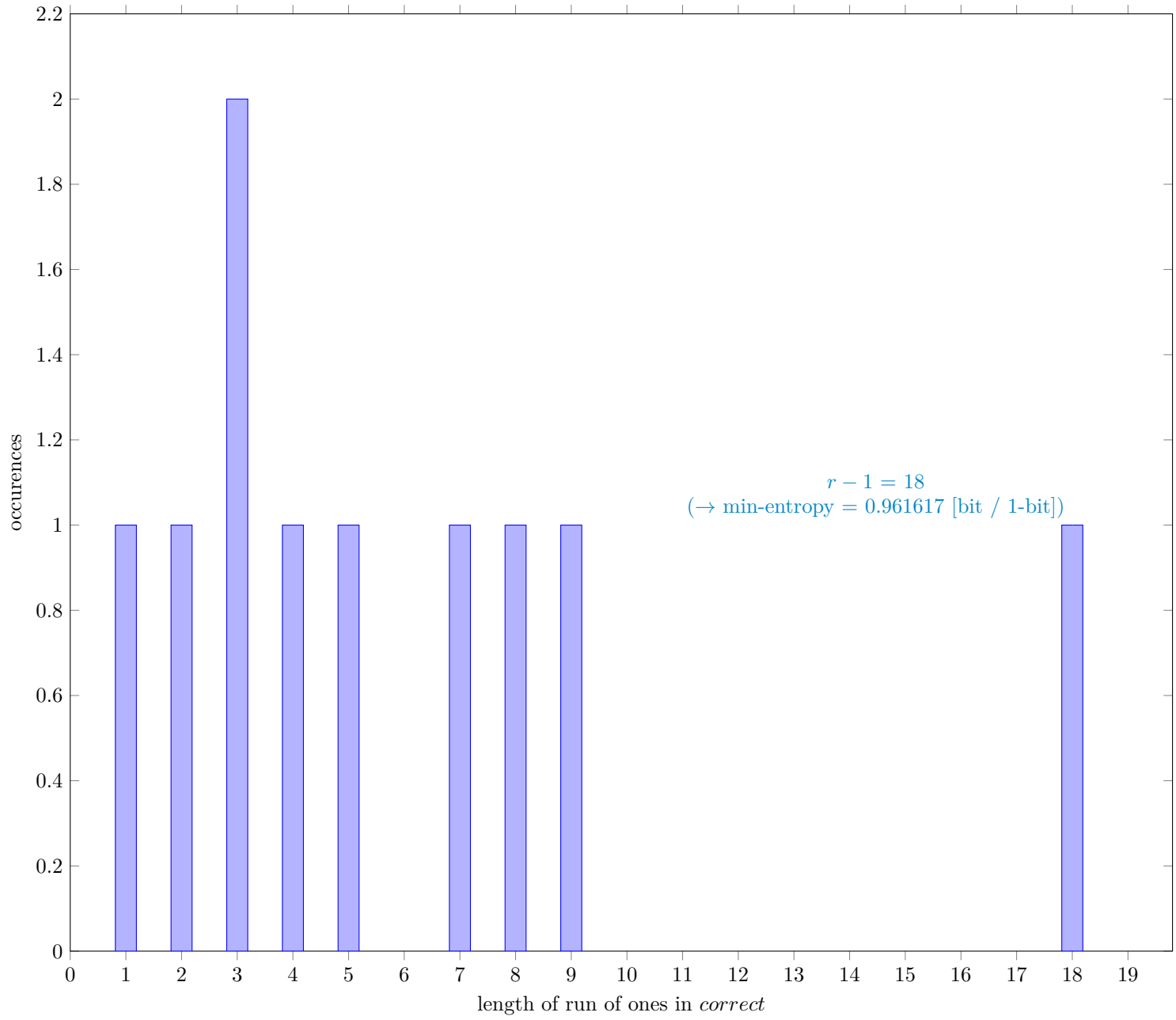


Fig. 11 Distribution of *correct*

3.9.1 Supplemental information for traceability

Table 12 Supplemental information for traceability (NIST SP 800-90B Section 6.3.9)

Symbol	Value
N	9998
C	5005
P_{global}	0.5006
P'_{global}	0.513481
r	19
P_{local}	0.501512

3.10 The LZ78Y Prediction Estimate (NIST SP 800-90B Section 6.3.10)

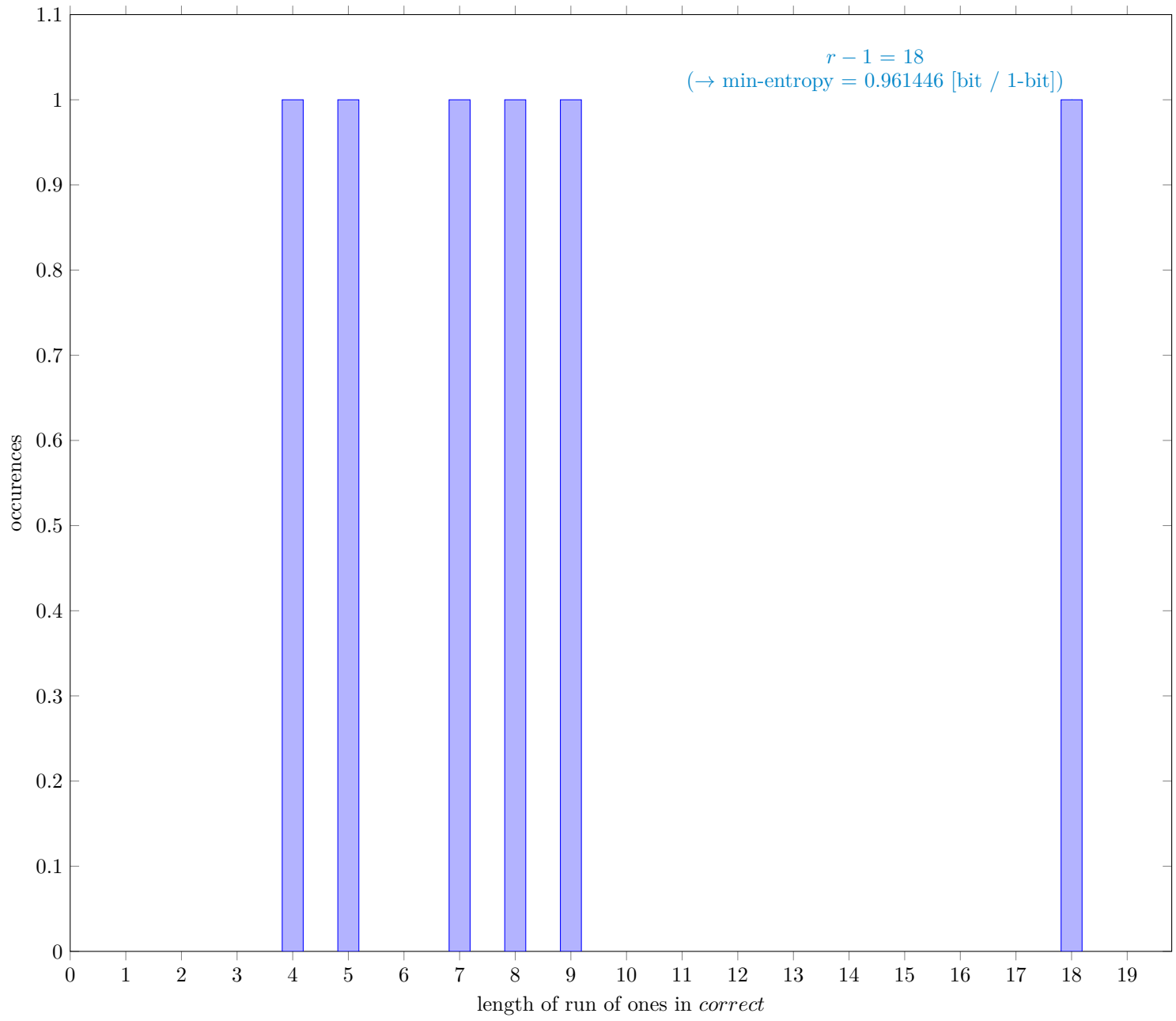


Fig. 12 Distribution of *correct*

3.10.1 Supplemental information for traceability

Table 13 Supplemental information for traceability (NIST SP 800-90B Section 6.3.10)

Symbol	Value
N	9983
C	4998
P_{global}	0.500651
P'_{global}	0.513542
r	19
P_{local}	0.501554

3 References

[1] Meltem Sönmez Turan, Elaine Barker, John Kelsey, Kerry A. McKay, Mary L. Baish, Mike Boyle *Recommendation for the Entropy Sources Used for Random Bit Generation*, NIST Special Publication 800-90B, Jan. 2018

[2] G. Sakurai, *Proposed list of corrections for NIST SP 800-90B 6.3 Estimators*, Dec. 2022 `https://github.com/g-g-sakura/AnotherEntropyEstimationTool/blob/main/documentation/ProposedListOfCorrections_SP800-90B.pdf`