A: Datasheet

Algorithm: kakao_000

Developer: [**Developer name**]

Submission Date: 2021_06_23

Investigation:

Frontal mugshot ranking 14 (out of 280) −− FNIR(1600000, 0, 1) = 0.0015 vs. lowest 0.0009 from sensetime_005

Mugshot webcam ranking 23 (out of 242) −− FNIR(1600000, 0, 1) = 0.0106 vs. lowest 0.0062 from sensetime_005

Mugshot profile ranking 14 (out of 211) −− FNIR(1600000, 0, 1) = 0.1187 vs. lowest 0.0587 from xforwardai_002

Immigration visa−border ranking 14 (out of 169) −− FNIR(1600000, 0, 1) = 0.0024 vs. lowest 0.0013 from visionlabs_010

Immigration visa−kiosk ranking 11 (out of 166) −− FNIR(1600000, 0, 1) = 0.0781 vs. lowest 0.0568 from cloudwalk_hr_000

Identification:

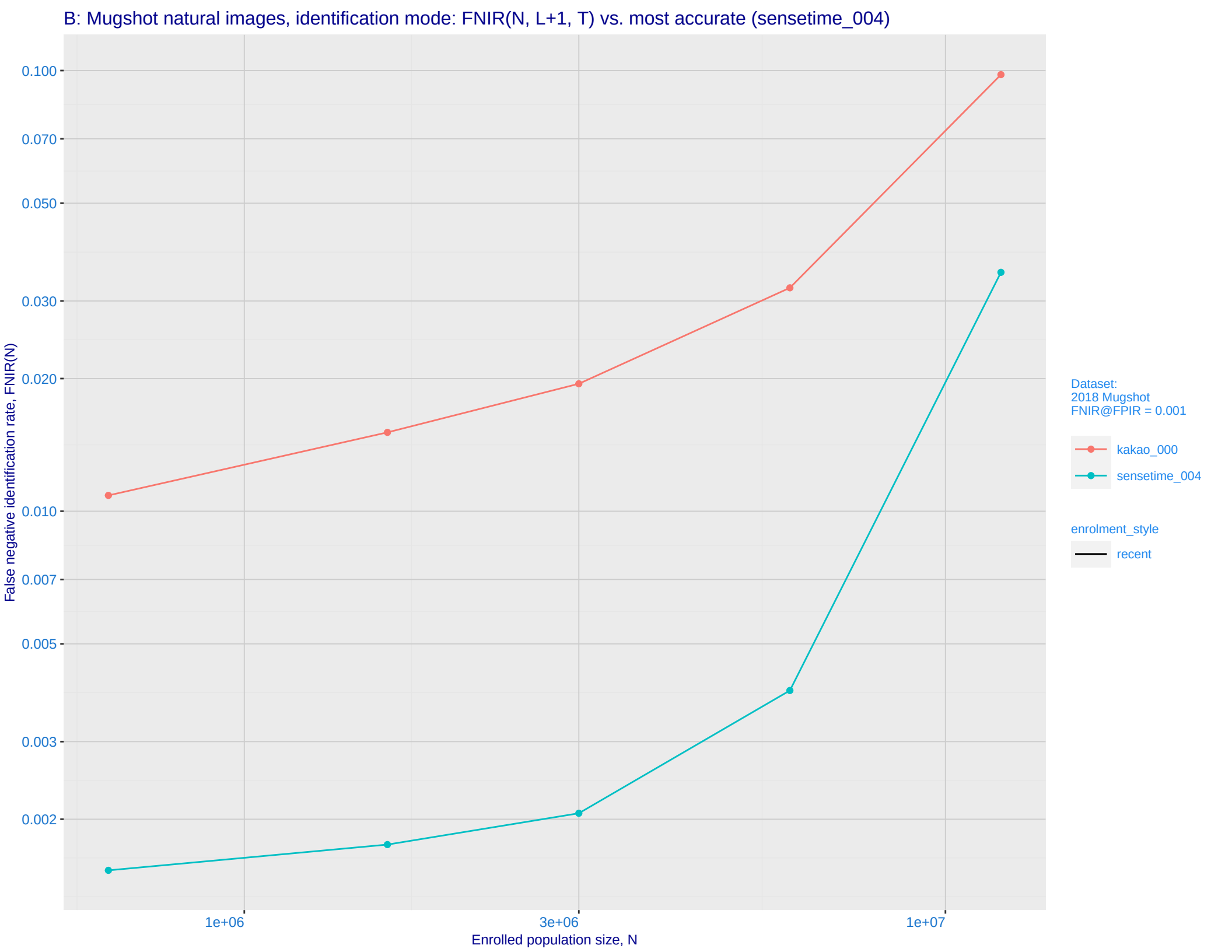
Frontal mugshot ranking 32 (out of 280) −− FNIR(1600000, T, L+1) = 0.0151, FPIR=0.001000 vs. lowest 0.0018 from sensetime_004

Mugshot webcam ranking 35 (out of 237) −− FNIR(1600000, T, L+1) = 0.0558, FPIR=0.001000 vs. lowest 0.0122 from sensetime_003

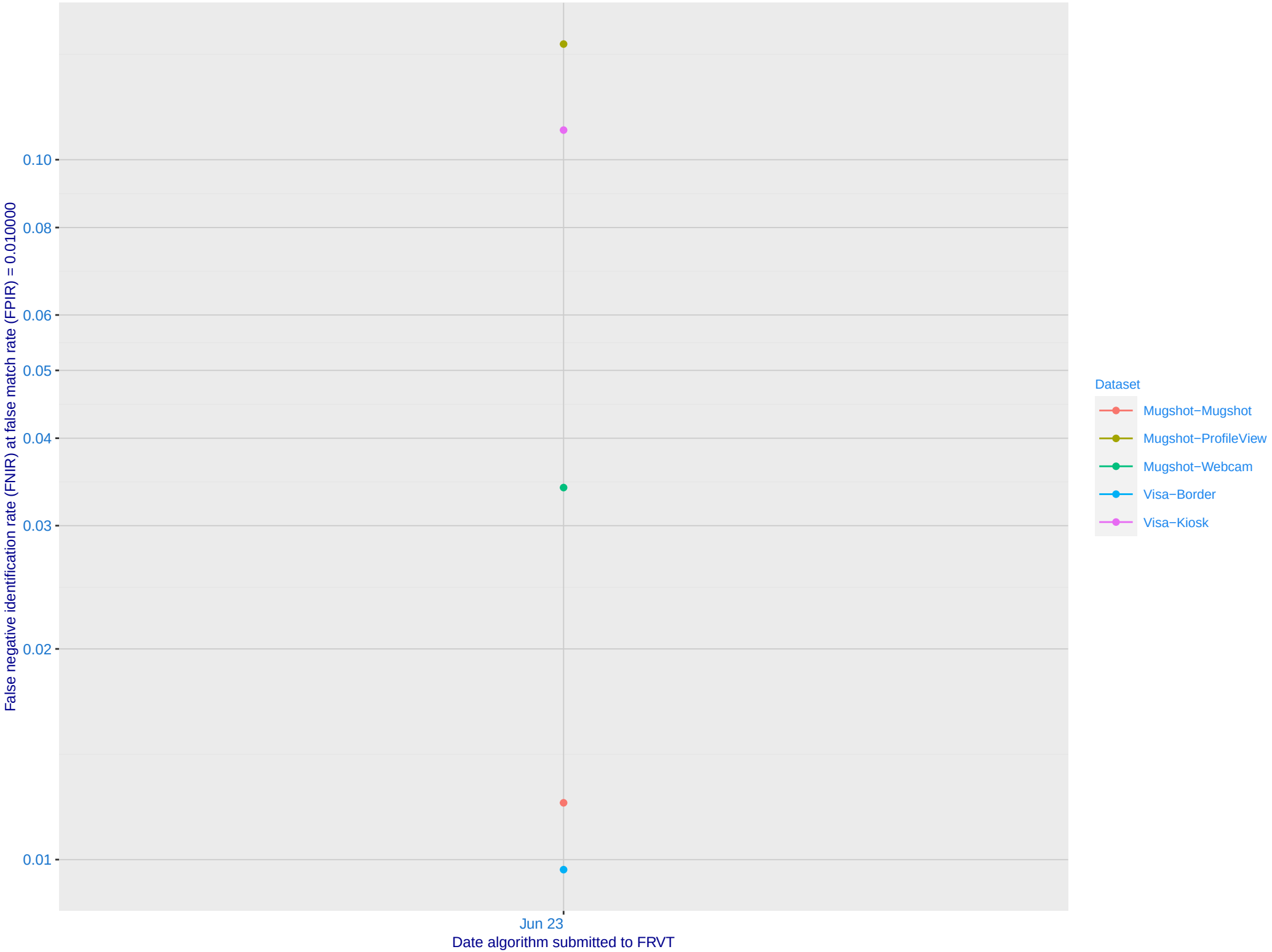
Mugshot profile ranking 10 (out of 210) −− FNIR(1600000, T, L+1) = 0.4681, FPIR=0.001000 vs. lowest 0.1331 from cloudwalk_hr_000

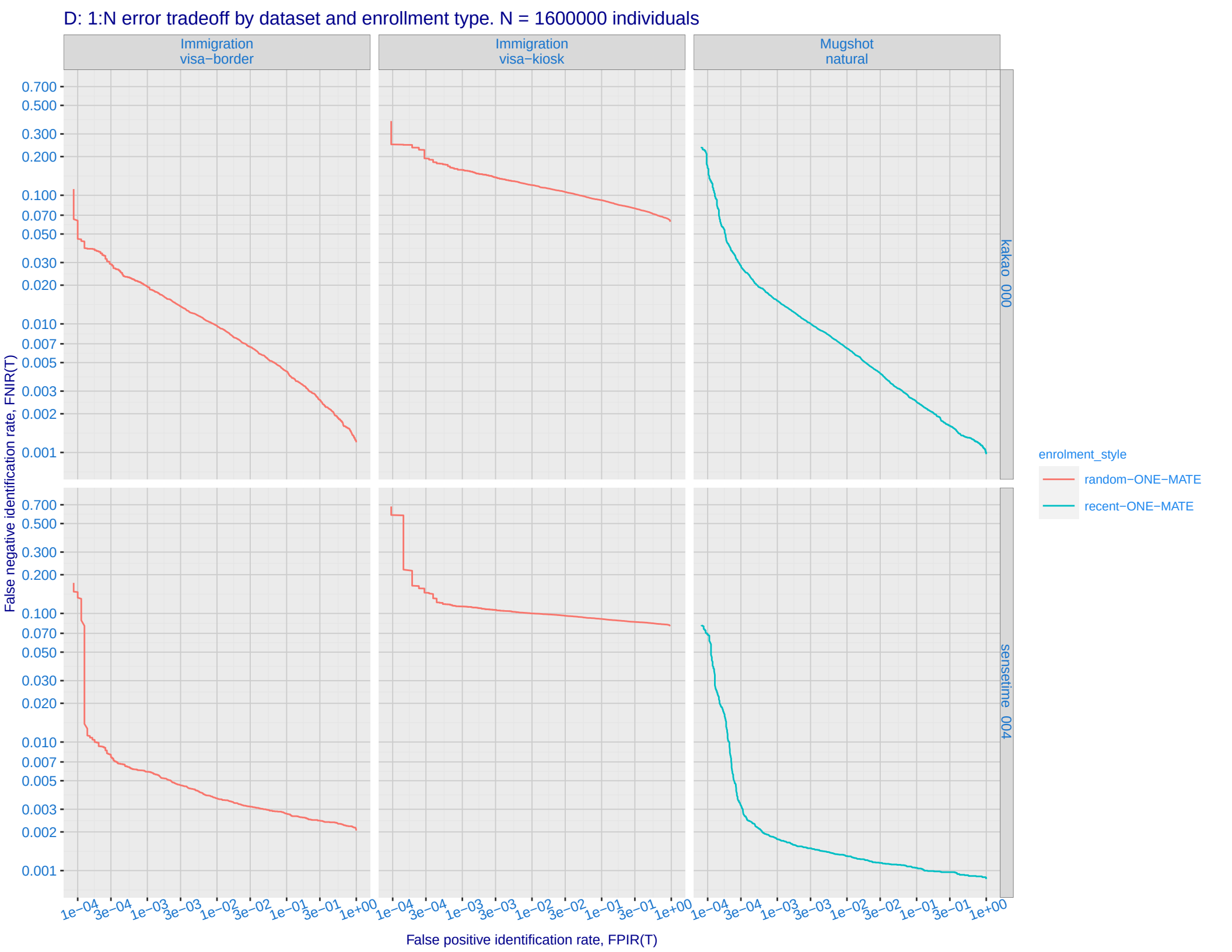
Immigration visa−border ranking 23 (out of 168) −− FNIR(1600000, T, L+1) = 0.0195, FPIR=0.001000 vs. lowest 0.0047 from idemia_008

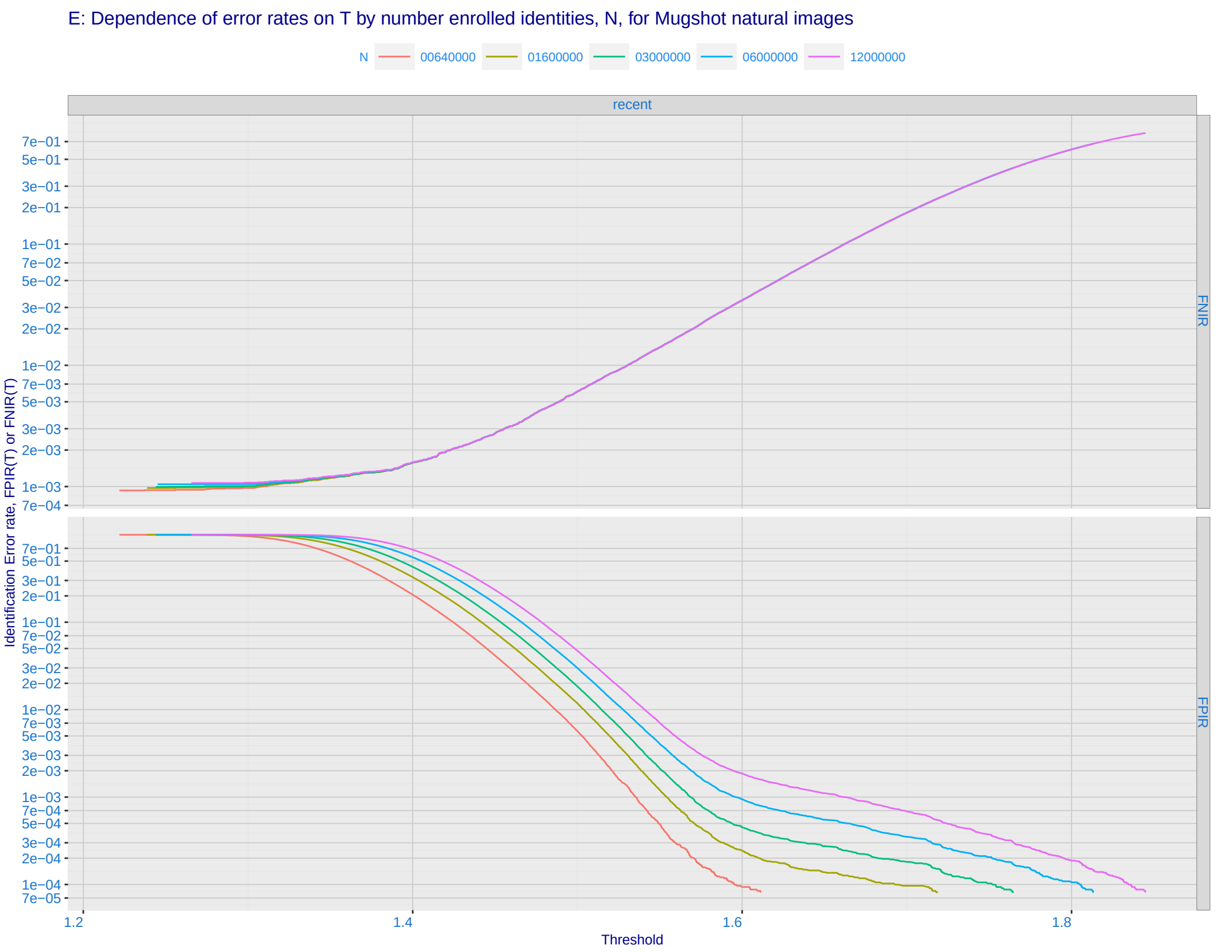
Immigration visa−kiosk ranking 14 (out of 163) −− FNIR(1600000, T, L+1) = 0.1578, FPIR=0.001000 vs. lowest 0.0996 from cloudwalk_hr_000

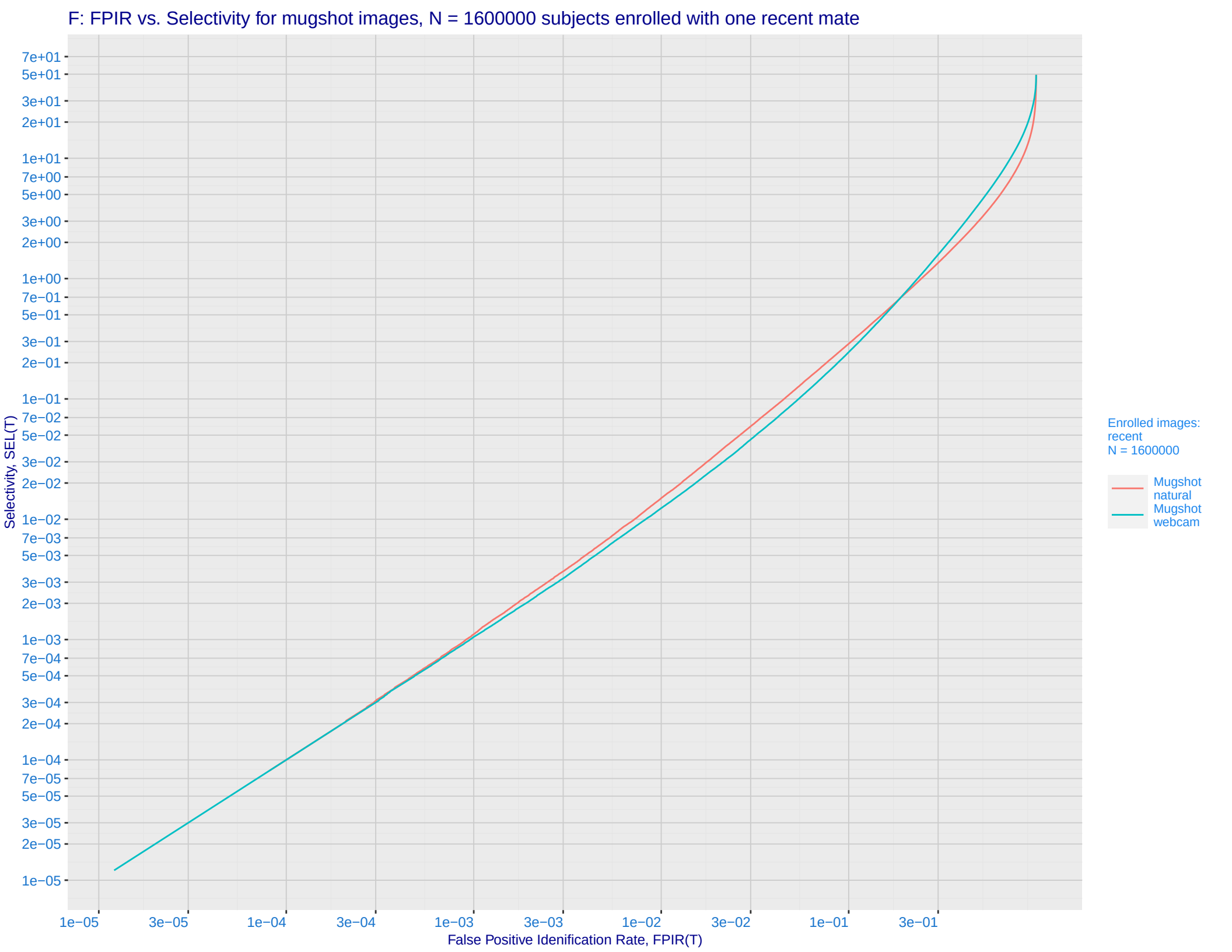

B: Mugshot natural images, identification mode: FNIR(N, L+1, T) vs. most accurate (sensetime_004)
False negative identification rate, FNIR(N)
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
1e+06
3e+06
1e+07
Enrolled population size, N
Dataset:
2018 Mugshot
FNIR@FPIR = 0.001
kakao_000
sensetime_004
enrolment_style
recent

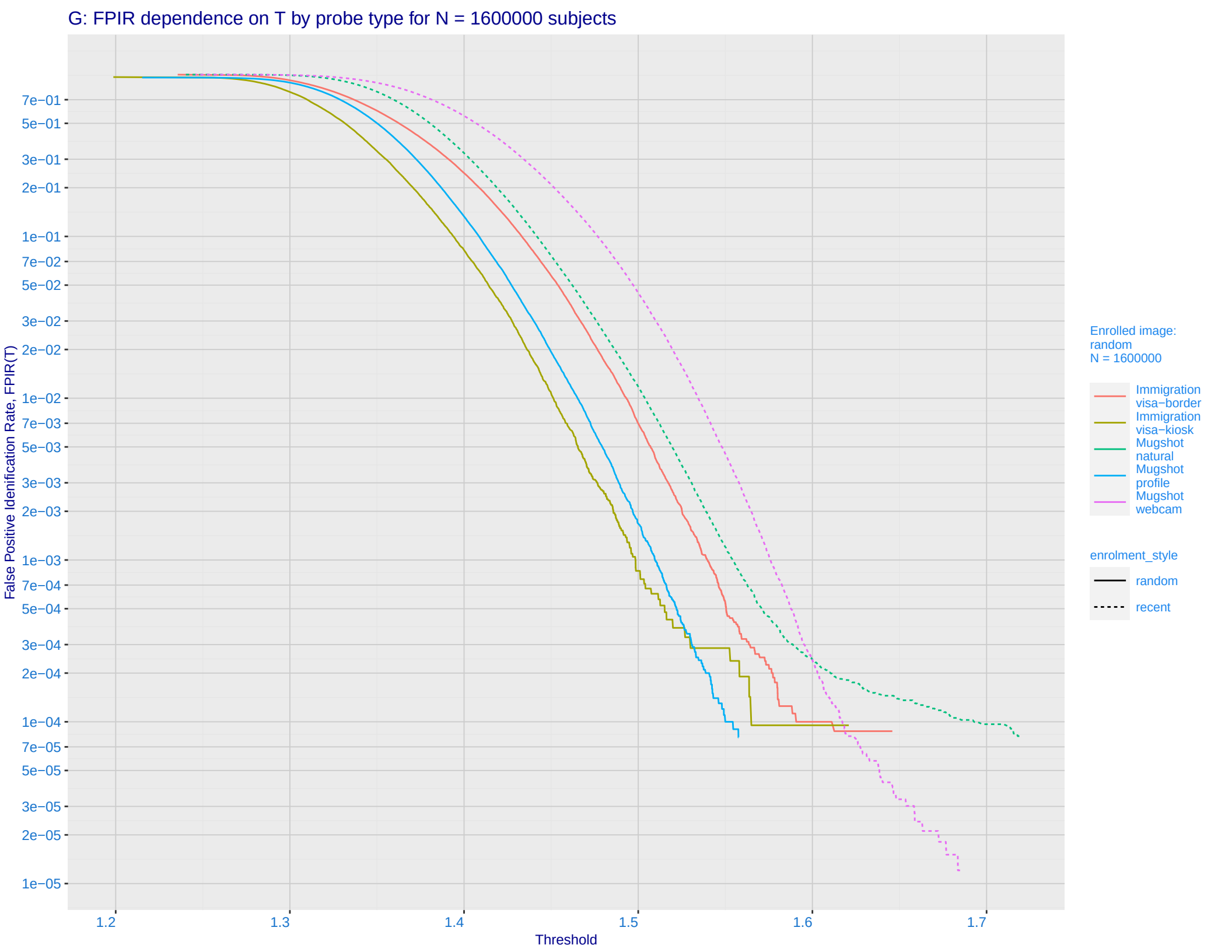
C: Evolution of accuracy for KAKAO algorithms on three datasets 2018 − present

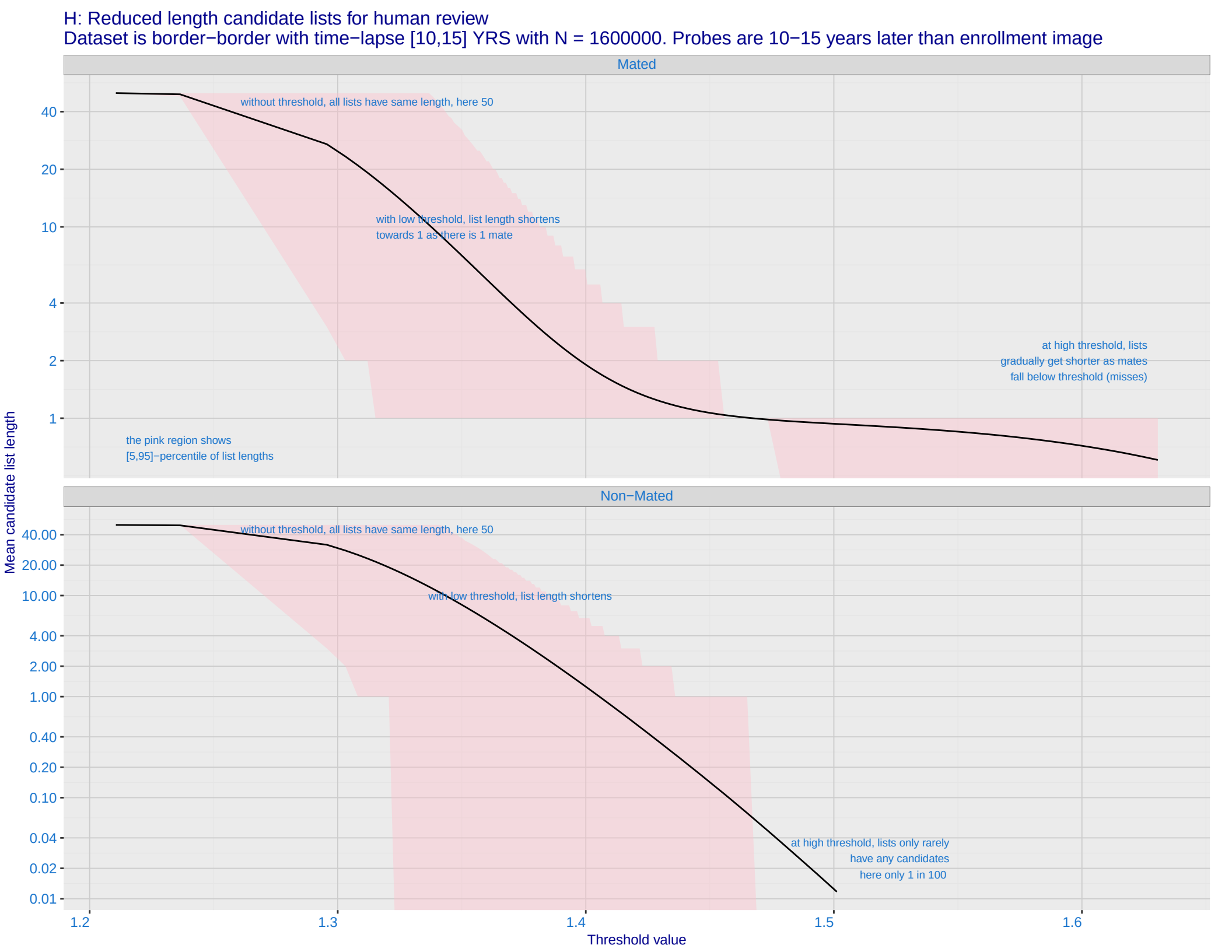



D: 1:N error tradeoff by dataset and enrollment type. N = 1600000 individuals
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
kakao 000
sensetime 004
False negative identification rate, FNIR(T)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
1e+00
False positive identification rate, FPIR(T)
enrolment_style
random−ONE−MATE
recent−ONE−MATE

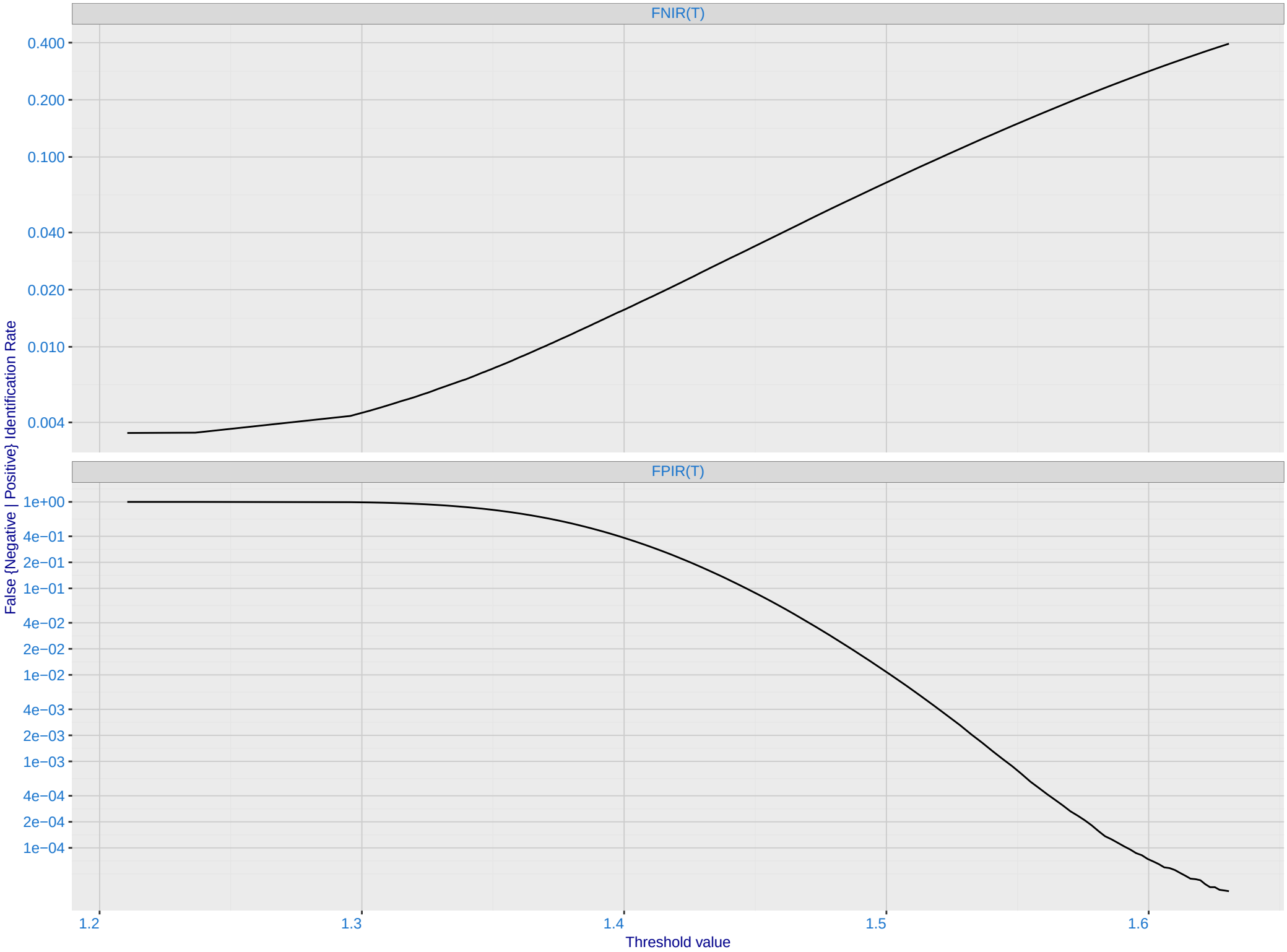

E: Dependence of error rates on T by number enrolled identities, N, for Mugshot natural images
N
00640000
01600000
03000000
06000000
12000000
recent
FNIR
FPIR
Identification Error rate, FPIR(T) or FNIR(T)
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
1.2
1.4
1.6
1.8
Threshold

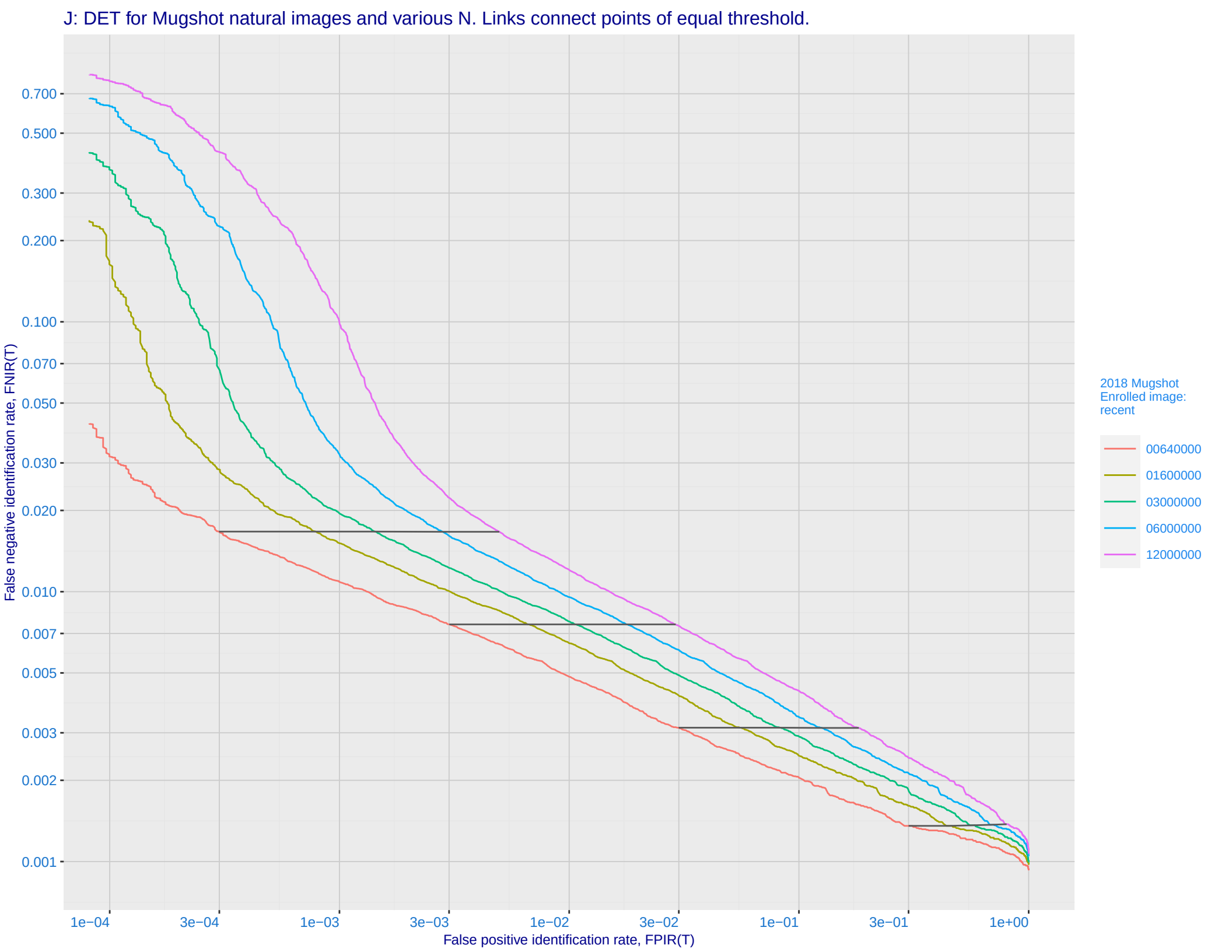

F: FPIR vs. Selectivity for mugshot images, N = 1600000 subjects enrolled with one recent mate
Selectivity, SEL(T)
7e+01
5e+01
3e+01
2e+01
1e+01
7e+00
5e+00
3e+00
2e+00
1e+00
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
5e−05
3e−05
2e−05
1e−05
1e−05
3e−05
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
False Positive Idenification Rate, FPIR(T)
Enrolled images:
recent
N = 1600000
Mugshot
natural
Mugshot
webcam

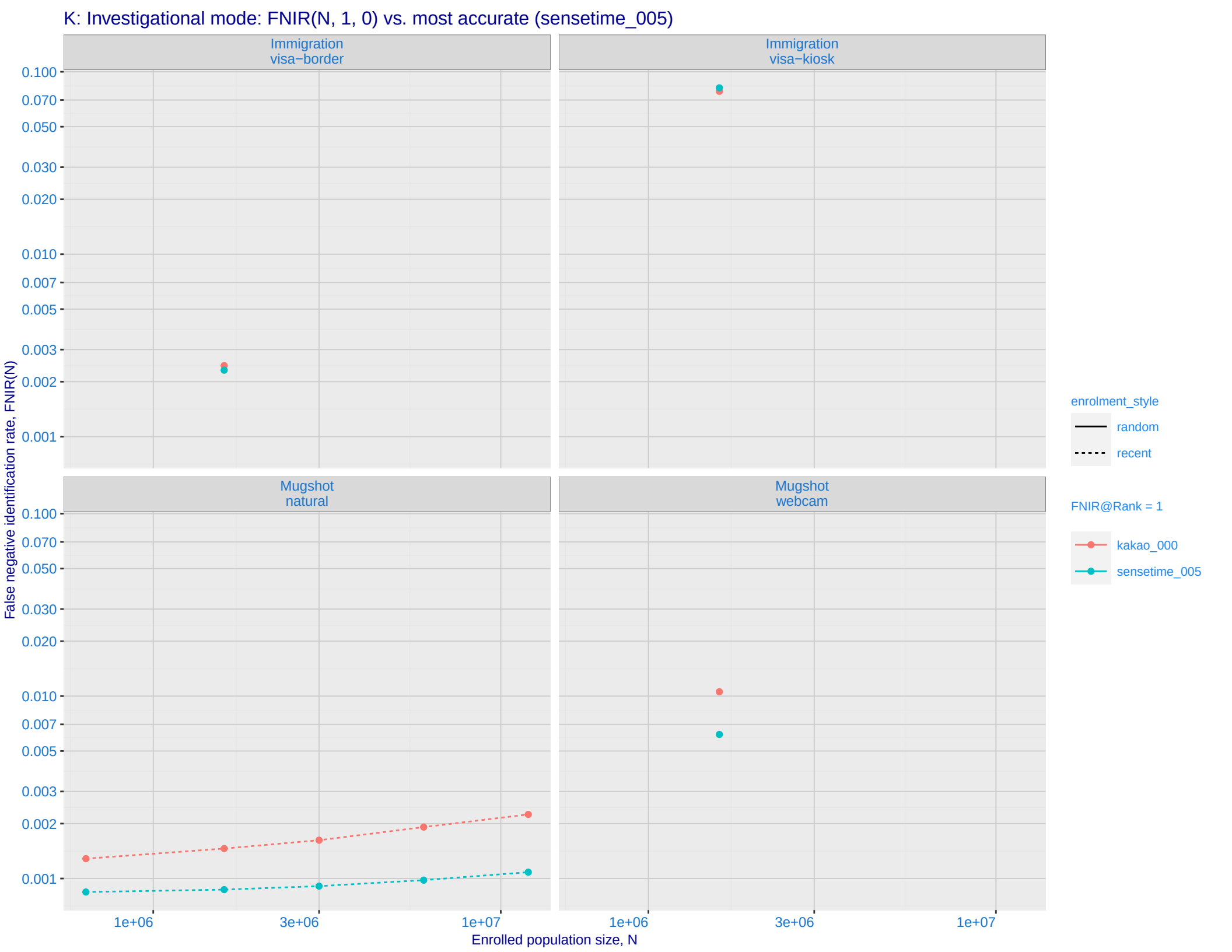

G: FPIR dependence on T by probe type for N = 1600000 subjects
False Positive Idenification Rate, FPIR(T)
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
5e−05
3e−05
2e−05
1e−05
1.2
1.3
1.4
1.5
1.6
1.7
Threshold
Enrolled image:
random
N = 1600000
Immigration
visa−border
Immigration
visa−kiosk
Mugshot
natural
Mugshot
profile
Mugshot
webcam
enrolment_style
random
recent

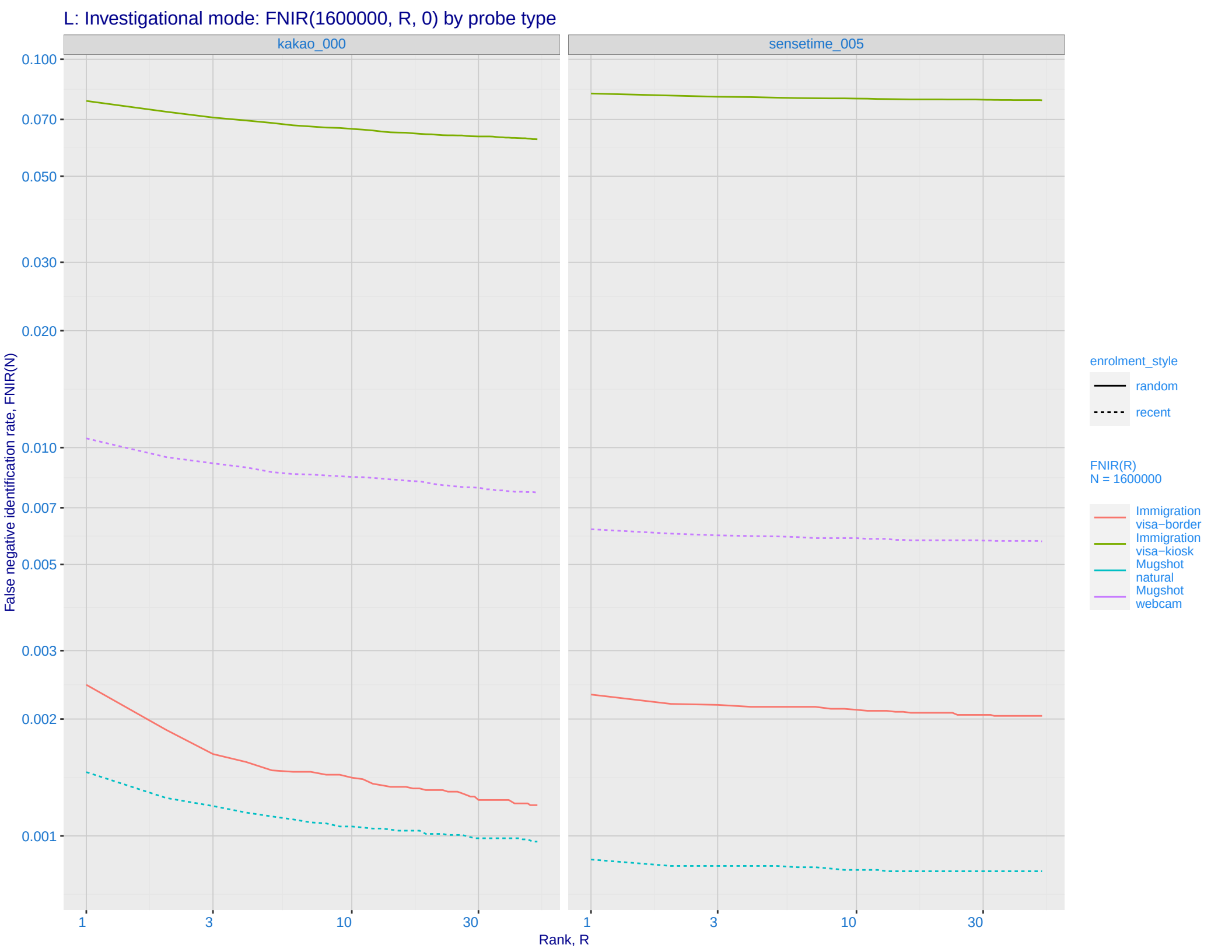

H: Reduced length candidate lists for human review
Dataset is border−border with time−lapse [10,15] YRS with N = 1600000. Probes are 10−15 years later than enrollment image
Mated
without threshold, all lists have same length, here 50
with low threshold, list length shortens
towards 1 as there is 1 mate
at high threshold, lists
gradually get shorter as mates
fall below threshold (misses)
the pink region shows
[5,95]−percentile of list lengths
Non−Mated
without threshold, all lists have same length, here 50
with low threshold, list length shortens
at high threshold, lists only rarely
have any candidates
here only 1 in 100
Mean candidate list length
Threshold value

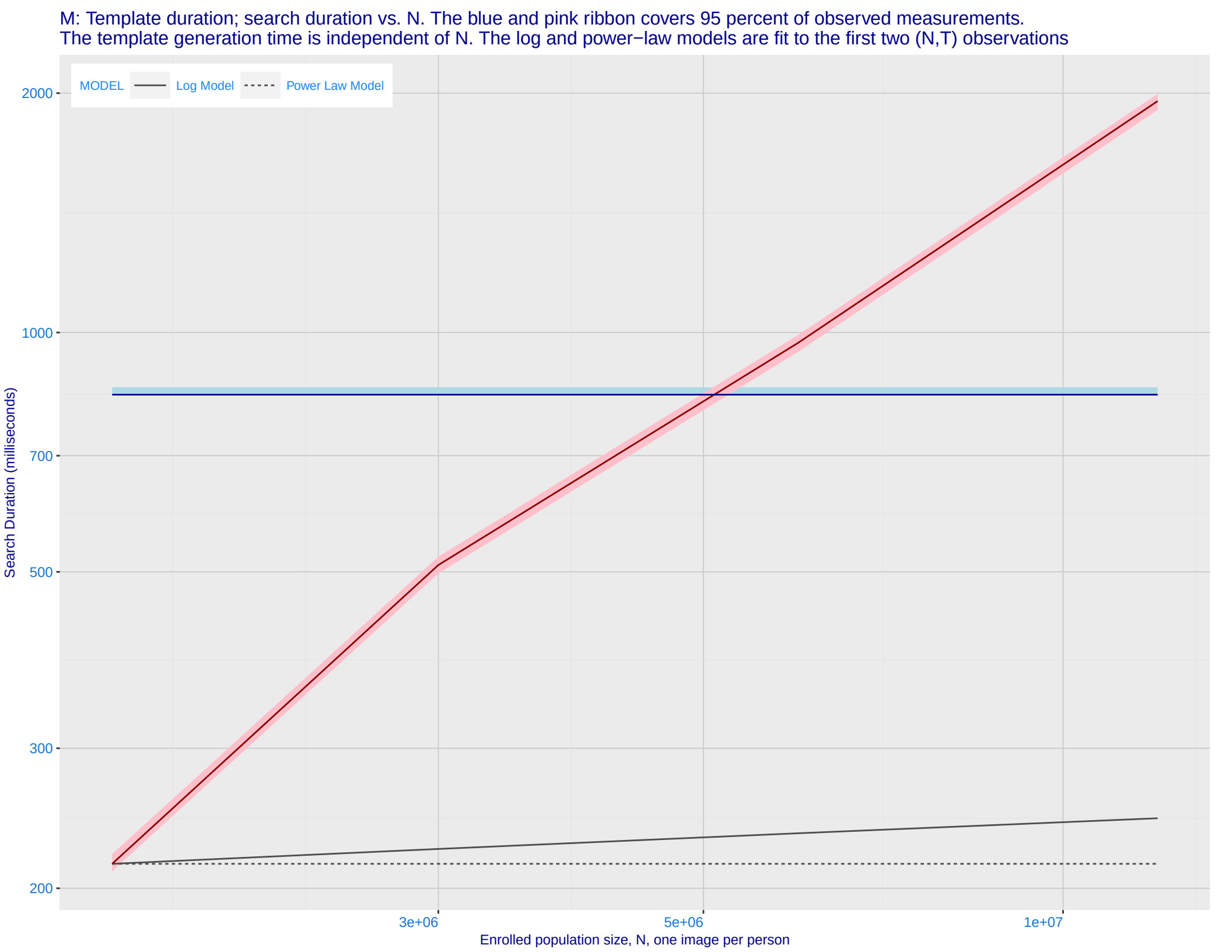
I: FNIR and FPIR dependence on threshold
Dataset is border−border with time−lapse [10,15] YRS with N = 1600000. Probes are 10−15 years later than enrollment image




J: DET for Mugshot natural images and various N. Links connect points of equal threshold.
False negative identification rate, FNIR(T)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
1e+00
False positive identification rate, FPIR(T)
2018 Mugshot
Enrolled image:
recent
00640000
01600000
03000000
06000000
12000000


K: Investigational mode: FNIR(N, 1, 0) vs. most accurate (sensetime_005)
Immigration
visa−border
Immigration
visa−kiosk
Mugshot
natural
Mugshot
webcam
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
False negative identification rate, FNIR(N)
1e+06
3e+06
1e+07
Enrolled population size, N
enrolment_style
random
recent
FNIR@Rank = 1
kakao_000
sensetime_005

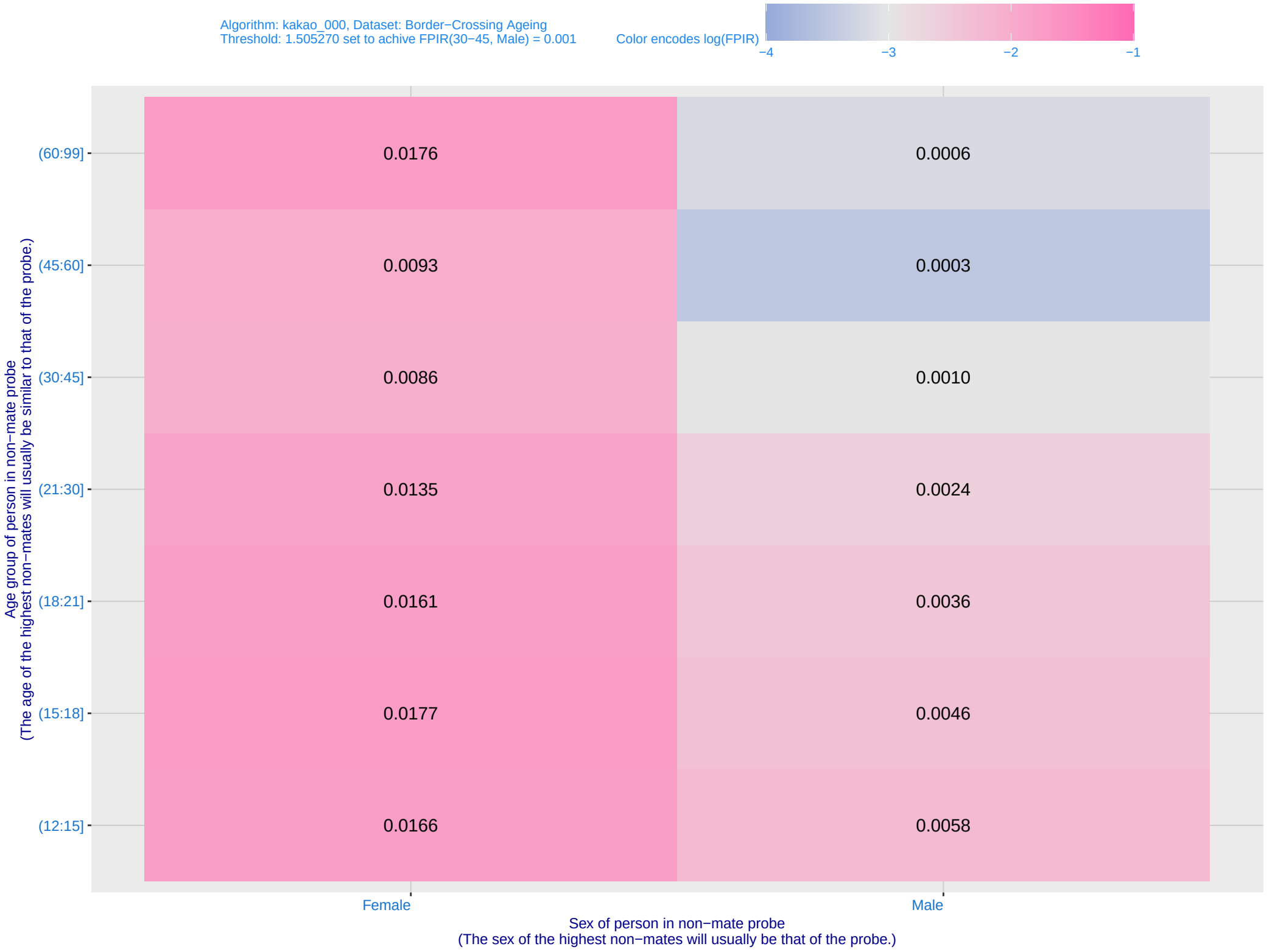

L: Investigational mode: FNIR(1600000, R, 0) by probe type
kakao_000
sensetime_005
False negative identification rate, FNIR(N)
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1
3
10
30
Rank, R
enrolment_style
random
recent
FNIR(R)
N = 1600000
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
Mugshot webcam

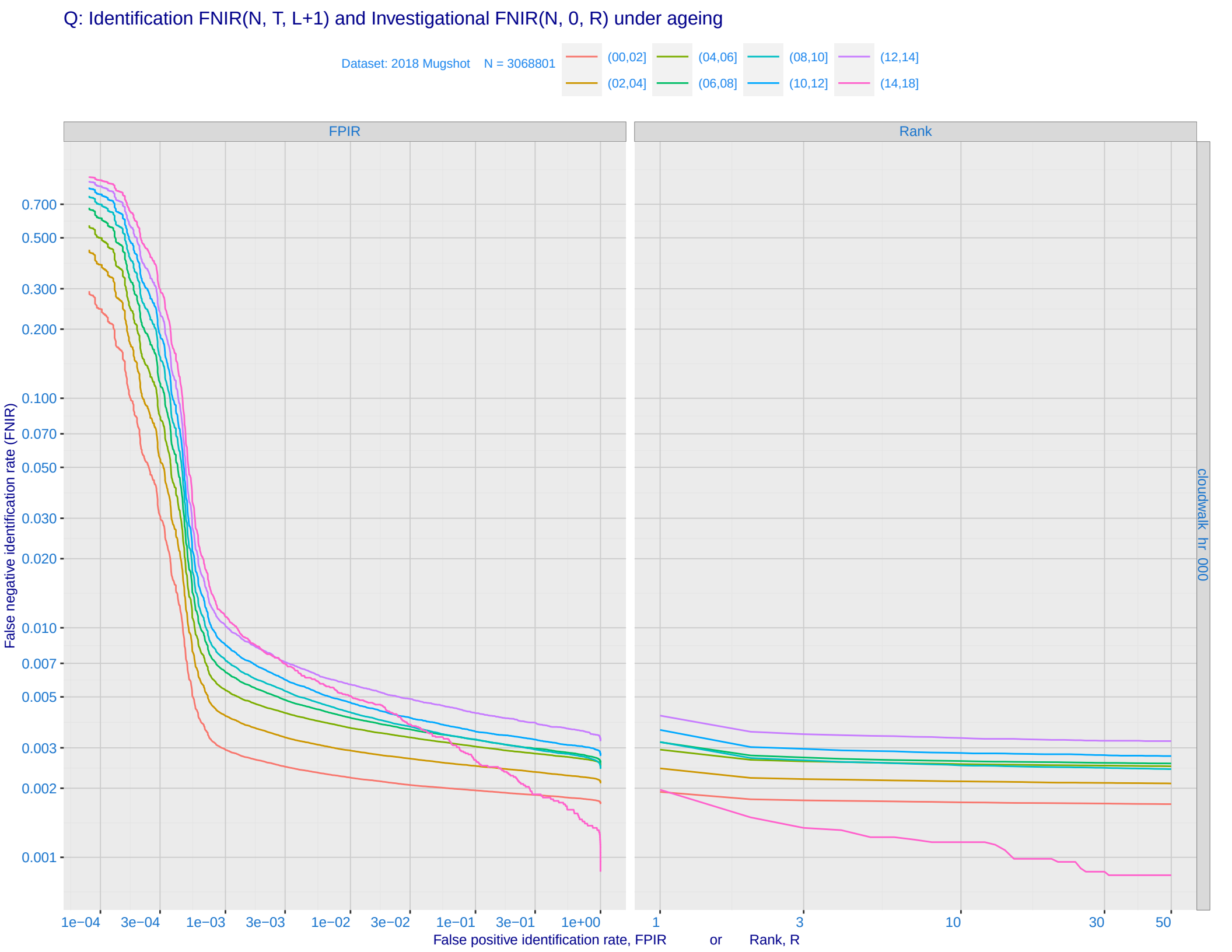

M: Template duration; search duration vs. N. The blue and pink ribbon covers 95 percent of observed measurements.
The template generation time is independent of N. The log and power−law models are fit to the first two (N,T) observations
MODEL
Log Model
Power Law Model
2000
1000
700
500
300
200
Search Duration (milliseconds)
3e+06
5e+06
1e+07
Enrolled population size, N, one image per person

O: FNIR(T, N = 1.6 million) by sex, age and time−lapse. The top row gives investigational rank−1 miss rates.
The bottom panels give high threshold for more lights−out identification with low FPIR.

Age group at time of enrollment	Female						Male					
	Time between probe and enrollment (years)											
	10	11	12	13	14	15	10	11	12	13	14	15
FNIR(R=1, T=0)												
(60:99]	0.012	0.014	0.017	0.018	0.021	0.025	0.005	0.004	0.004	0.003	0.005	0.008
(45:60]	0.011	0.011	0.013	0.014	0.016	0.015	0.003	0.003	0.004	0.005	0.004	0.004
(30:45]	0.011	0.011	0.013	0.015	0.016	0.018	0.004	0.003	0.004	0.005	0.005	0.004
(21:30]	0.016	0.016	0.017	0.019	0.021	0.019	0.006	0.005	0.005	0.006	0.007	0.007
(18:21]	0.031	0.027	0.031	0.033	0.032	0.025	0.012	0.013	0.016	0.015	0.017	0.016
(15:18]	0.044	0.041	0.044	0.047	0.048	0.047	0.034	0.031	0.035	0.044	0.042	0.058
(12:15]	0.059	0.048	0.053	0.064	0.065	0.045	0.058	0.065	0.078	0.079	0.087	0.065
FNIR(R=50, T=1.505270), FPIR(30−45, Male) = 0.001												
(60:99]	0.060	0.065	0.081	0.087	0.098	0.114	0.038	0.038	0.043	0.057	0.055	0.068
(45:60]	0.056	0.056	0.067	0.079	0.088	0.097	0.030	0.032	0.040	0.047	0.051	0.055
(30:45]	0.062	0.068	0.078	0.088	0.100	0.094	0.030	0.028	0.037	0.045	0.052	0.051
(21:30]	0.085	0.082	0.093	0.107	0.112	0.117	0.046	0.046	0.056	0.066	0.076	0.072
(18:21]	0.140	0.134	0.145	0.164	0.170	0.164	0.124	0.120	0.136	0.149	0.171	0.169
(15:18]	0.188	0.177	0.190	0.211	0.226	0.166	0.252	0.258	0.275	0.311	0.332	0.348
(12:15]	0.246	0.234	0.246	0.268	0.283	0.276	0.391	0.377	0.429	0.461	0.483	0.493

P: FPIR(N = 1.6 million) by sex and age. It is typical for false positive identification rates to be higher in women except in their teens.




Q: Identification FNIR(N, T, L+1) and Investigational FNIR(N, 0, R) under ageing
Dataset: 2018 Mugshot N = 3068801
(00,02]
(02,04]
(04,06]
(06,08]
(08,10]
(10,12]
(12,14]
(14,18]
FPIR
Rank
False negative identification rate (FNIR)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
1e+00
1
3
10
30
50
False positive identification rate, FPIR or Rank, R
cloudwalk hr 000