



!"#\$%&' (&)* +, "&- . "/0&1%* + /&2/34\$%5367!
!"#\$%&' ()!* +!, -%./!* +0*!
122' !34//252!



6\$71.82!



?(;B5%4\$8' !

9%4 - 2%7.2&!4:!2; #4!%2' \$-/.; (7.48!
; %4&&/.85\$.&7.; (//)!



C; #4!%2' \$-/.; (7.48!

1\$/8",3&

[!oli]! '(//2)'!

[oli !oli]! '(//2)&!27;E'!

1\$/8",3&

[ka"i]! '; 4\$5#'!

[ka"i t_Fa"i]! '; 4\$5#D!27;E'

!

9/8,35. &

[k#f]! '; 4\$5#'!

[k#f "m_F#f]! '; 4\$5#_{FG<@G<<GHC}'!



1. $J^2 \cdot K \cdot 25 = 287! \cdot 2^7 \cdot 5^{-1} \cdot 7$; (7.48)

$G^8 \cdot I < 10!$ $!L < M! \cdot (4; \cdot (72^7 \cdot !N \cdot 7 \cdot !C!$
- $(\%7.; \$ / (\%!; 48 \& 7\% \$; 7.48! \cdot \&!; 4 \$ 8^7 \cdot ! \cdot 8! 7 \cdot \# 2! 1!$

"#2!0J2' != (72%. (!; (8!P20!

, !; 48&48 (87!L = 4&7!; 4 = = 48M!

, !>4N2/!

, !3H!&2A\$28; 2!

, !&72 = !



1. J2' K&25 = 287!%2' \$ -/.; (7.48!

- "5. #3%3&: - *' ,;0!<_!R![\$_F]^0&

[nalk%]! ':(\$; 27' &

[nalk% \$_Falk%]! ':(\$; 27D!27; E'

<=> # " * & : ? * % 6 \$ / 5 \$ / & @ A A B ; 0 ! < _ ! R ! [í _ F] &

[an&' (u)! '= 4 \$ 7 # ' &

[án&' í _ F án&' (u)! ' ; # 2 2 B & D ! 8 4 & 2 D ! 2 7 ; E ' !



1. J2' K&25 = 287!%2' \$ -/.; (7.48!

C" #3,&: - \$" / \$&@AAD;0!<_!R![ki_F]^{0!}

[\$e)*ai]! 'N#.72' &

[\$e)*ai ki_F)*ai]! 'N#.72D!27;E' !

E' 553" /&:F* (*G%7"\$4&@AD@;0!<_!R![xuj_F]!W! '-28.&' &

[mál+, ik]! 'P4)' &

[mál+, ik xuj_Fál+, ik]! 'P4)_{FG<@G<<GHC}' !

!



C; #4!%2' \$-/.; (7.48!

") - .; (//)!; 48>2)&!

'YD!27;E' !

'Y!(8' !(&&4;. (72' !7#.85&' !

'Y!.8!5282%(/' !

'&\$-2%&27!4: !N#.; #!Y!.&!(!=2=P2%' !

G8!&4 = 2!/5&D!.7!; 48>2)&!(! 7482!

1 \$&&. (80![mál+, ik xuj_Fál+, ik]! 'P4)_{FG<@G<<GHC}' !



6P/5 (74%)! ? 1K848.' 287.7)!

@4&7!& (/ .287! !4: !2; #4!

%2' \$- /.; (7.48!.&!

Z0!-#484/45.; (/! . [2%28; 2!P27N228!?!(8' !1!

!.8!1!\$&\$ (//)!284\$5#!74!

- "5. #3%3&: - *' ,;&

[nalk%! ![nalk% \$_Falk%! ' : (\$; 27D!27; E' !

,

- "5. #3%3&: - *' ,;&

[\$a*z%! !\[\$a*z% \$_Fa*z%\! ' ; 44BD!27; E' !



6P/5 (74%)! ? 1K848.' 287.7)!

]5&!(>4.' !&\$; #!; (&2&!4: !-47287.(/! ? 1K
' 287.7)! P)! 2.7# 2%Q!

^&.85!(!' 2&.58(72' !

3#44&.85!:%4 =!(= 485!7#2!

!.8&72(' !4:!.8!1!

F22 = .85!7#2! - #%(&2!

6P/5 (74%)!/?1K848.' 287.7)!

@(8)!/5&!#(>2!(! D!B2-7!48!%2&2%>2!

:4%!(;&2&!4:!/?1K.' 287.7)!

<GH. "I&:J"" K&DLLM;N&<_!R![m_F]!L [/_]M&

/!áOak' / [!áOak' m_FáOak']! ' :44/D!27;E'!

//1k' / [/1k' m_F1k']! '#4%&2D!27;E'!

/maat/ *[maat m_Faát-] [maat /_Faát-]! '=482)D!27;E'



6P/5 (74%)! ? 1K848.' 287.7)!

67#2%/5&!# (>2! D! (/N ()&!

; #44&.85!482!7# (7!(>4.' &! ? 1K.' 287.7)!

0""%53&:P. "/3"G" (3&\$6&" ,0&@AAM;N&<_!R![m_F] ~ [p_F]!

/tæ23zu/ [tæ23zu m_Fæ23zu] ~ [tæ23zu p_Fæ23zu]! ' & ; (/2D!27; E' !

/zæ2if/ [zæ2if m_Fæ2if] ~ [zæ2if p_Fæ2if]! ' & /28' 2%D!27; E' !

/mive/ *[mive m_Five] ~ [mive p_Five]! ' :%\$.7D!27; E' !

/pi2/ [pi2 m_Fi2] ~ *[pi2 p_Fi2]! ' 4/' D!27; E' !



6P/5 (74%)! ? 1K848.' 287.7)!

<4 = 2!/5&!2>28!54!&4!: (%! (&!74!
N#28!1!N.7#!<_!N4\$/ ' !P2!.' 287.; (!/74!.7!
R, "553S", &C3G\$6" /&: 1\$7\$%&DLL@; N&<_!R![a_F] L ?![o_F]M&
/n4o!/ [n4a_F! n4o!]! '_\$ = P/2' !\$ - ' !
/! len/ [! la_Fn ! len]! '>2%)!&7\$ - . ' ' !
/5an/ *[5a_Fn 5an] [5an 5o_Fn]! '= .&2%(P/2' !



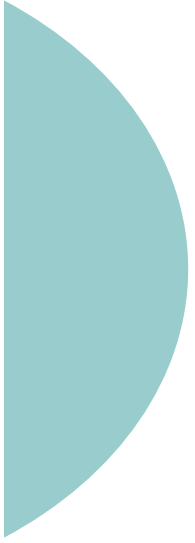
6P/.5 (74%)! ? 1K848.' 287.7)!


3%4&&/.85\$.&7.; (//)D!

"%.>2' .' &!L0aa+M!&\$%>2)!4:!! <1!.8!b0++!
G8' .(8!/5&!:4\$8' !

<22 = &!; /2 (%EEE!P\$7!G!&7.//!# (>2!482!A\$2&7.48Q!







3\$.4&.7)!:%4 = !/.72%(7\$.2!

U#(7!' 42&!7#.&! = 2(8\!

CJ-/(8(7.48!00!



G&!7#.&!C85/.&#K&-2;.0;\!

6%!= ()P2!N2' %2!(&&\$=.85!744!= \$; #!:%4=!
7#.&!482!' (7(!-4.87EEE!

G&!C85/.&#!2; #4!%2' \$-/.; (7.48!(!N2.%' !; (&2\!



@47.>(7.48!:4%(8!2J-2%.=287!


"4!08' !4\$7!..!2; #4!%2' \$-!.; (7.48!.8>4!>2&!
?1K848.' 287.7)!4%!?1K' .&&. =./(%7)EEE!

U2!822' !74!&7\$')!(!/5!.8!N#.; #0!

C; #4!%2' \$-!.; (7.48!.&!(!

!!

,



CJ-2%. = 287!

U# (7!2; #4!%2' \$-!.; (7.48!%2>2 (/&!
(P4\$7!-#484/45.; (!&. = ./(%7)!



CJ-2%. = 2870!A\$2&7.48!

h\$2&7.480!

\!

!74!2J(;7!

, 8)!?1K' .[2%28; 2!\$/' !&\$i ;2!

!74!%2/(7.>2!

<4=2!?1K' .[2%28; 2&!(%28' 7!' .&&. =./(%!284\$5#!



$CJ - 2\% = 2870! \& \$P_2; 7\&! (8' ! - \%4; 2' \$\%2!$

$!N.7\#!8 (7.>2! \& - 2(B2\%$

$(' \$/7\&!L8Re+M!$

$j 2(\% ' !(\$ ' .4!\%2; 4\%' .85!4:!(!N4\%' !$

$6\%' 2\%!N(\&!\%(8' 4 = .c2' !:4\%!2(; \#!\& - 2(B2\%$

$, \&B2' !74!$

$F.' !\& - 2(B2\%!\$ \&2!' 2: (\$/7![t_F]\!$

$6\%! ' .' !\#2k\&\#2!\$ \&2!(!P(; B\$ - !<_1 \!$



CJ-2% = 2870!&7. = \$/!

V+!72&7!N4%' &!:2//!\$8' 2%

Q!

Q![t] !N4%' &

Q!N4%' &!N.7#![t]

CJ-2%. = 2870!&7. = \$/!

?285 (/!; 48&48(87!.8>2874%)!LS# (8!* +0+M!

	p b b'	t98d99	t t8 d d'		k k8 ! !'
			, , 8 & &'		
	f		s	"	h
			l :		
	m		n		(5)



CJ-2% = 2870!&7. = \$/!

	p b b'	t			



CJ - 2% = 2870!#) - 47#2&.&!0!

j) - 47#2&.&!00!?1K(&&2&& = 287!.&!

!N4%' &!N.//! !\$&2![t_F]

N4%' &!N.//!P2# (>2!/.B2!

N4%' &

N4%' &!N.//! !\$&2![t_F]



CJ - 2% = 2870!#) - 47#2&.&!*

j) - 47#2&.&!*0! ? 1K (&&2&& = 287!.& !

(; %4&&! - #482 = 2&!

!N4%' &!N.//! !\$&2![t_F]

N4%' &!N.//! P2# (>2!/.B2! !N4%' &

N4%' &!N.//! !\$&2![t_F]

!R!

!!!

CJ-2% = 2870!#) - 47#2&.&!e!

j) - 47#2&.&!e! ? 1K (&&2&& = 287!.&!
D!P\$7!(/ &4! !
(; %4&&! - #482 = 2&!

!N4%' &!N.//! ! \$&2![t_F]

N4%' &!N.//! ! \$&2![t_F]

N4%' &!N.//! ! \$&2![t_F]

!!! !!!

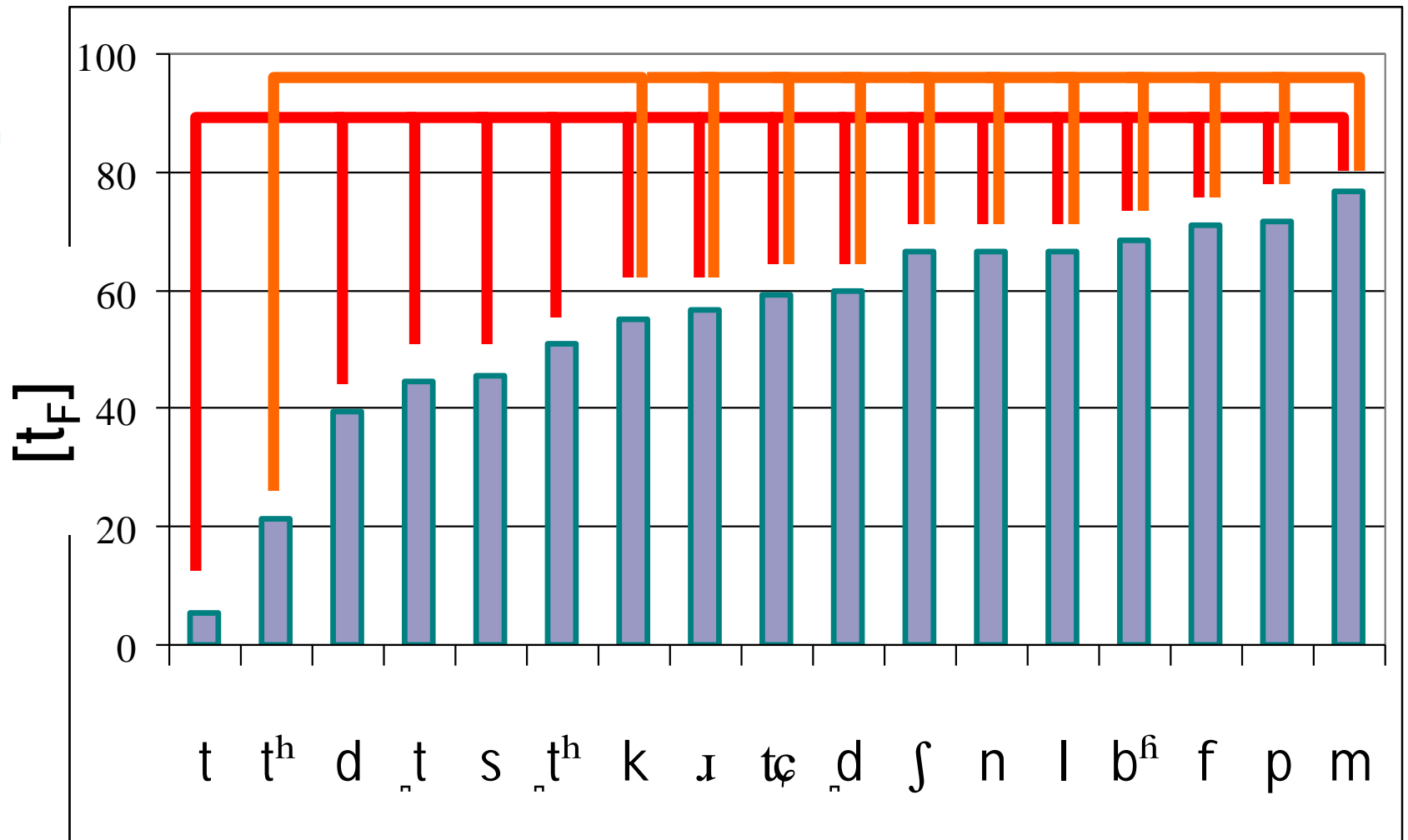
*[t...t_F] | ?[t8...t_F] R [b'...t_F]



12&\$/7&0!5282%(!!- (772%8!



12&\$/7&0!&.58.0; (87!' . [2%28; 2&!





12&\$/7&0!' 2&.58!.&&\$2&\!

U (&!7#2%2!(!-%4P/2=!N.7#!7#2!&27\$-\!

<#4\$/' !7#2!&. =. /(%7)!; 48' .7.48!(8' !; 487%4/!

; 48' .7.48!P2!%2' 2082' \!





12&\$/7&0!5%(' .287!&. = ./(%7)!

d4D!7#2%2!.&! !

.874!7N4!4%!7#%22!; (7254%.2&!

l \$%7#2%= 4%2D! !(; %4&&!7#2!

; /\$&72%&!7# (7! (%2!: 4\$8' !

3/2 (%/)D!



, 8 (/) & . & !

@2 (&\$%2 = 287!4:;!; 48&48 (87!
& . = ./ (%.7) !.8!?285 (/!



@4' 2/&!4:;!&. = ./(%7)!

9#484/45.; (!&. = ./(%7)!# (&!P228!
!.8!7#2!/.72%(7\$%2!

@4&7! = 27%.; &!8; 4%-4%(720!

34%%2/(7.48!N.7#!

3(8!2.7#2%!4:;!7#2&2! = 4' 2/! ?285 (/!
&-2(B2%&



<# (%2' !8 (7\$%(!!; /(&&2&0!.87%4' \$;7.48!



<# (%2' !8 (7\$%(!!; / (&&2&0!.87%4' \$; 7.48!

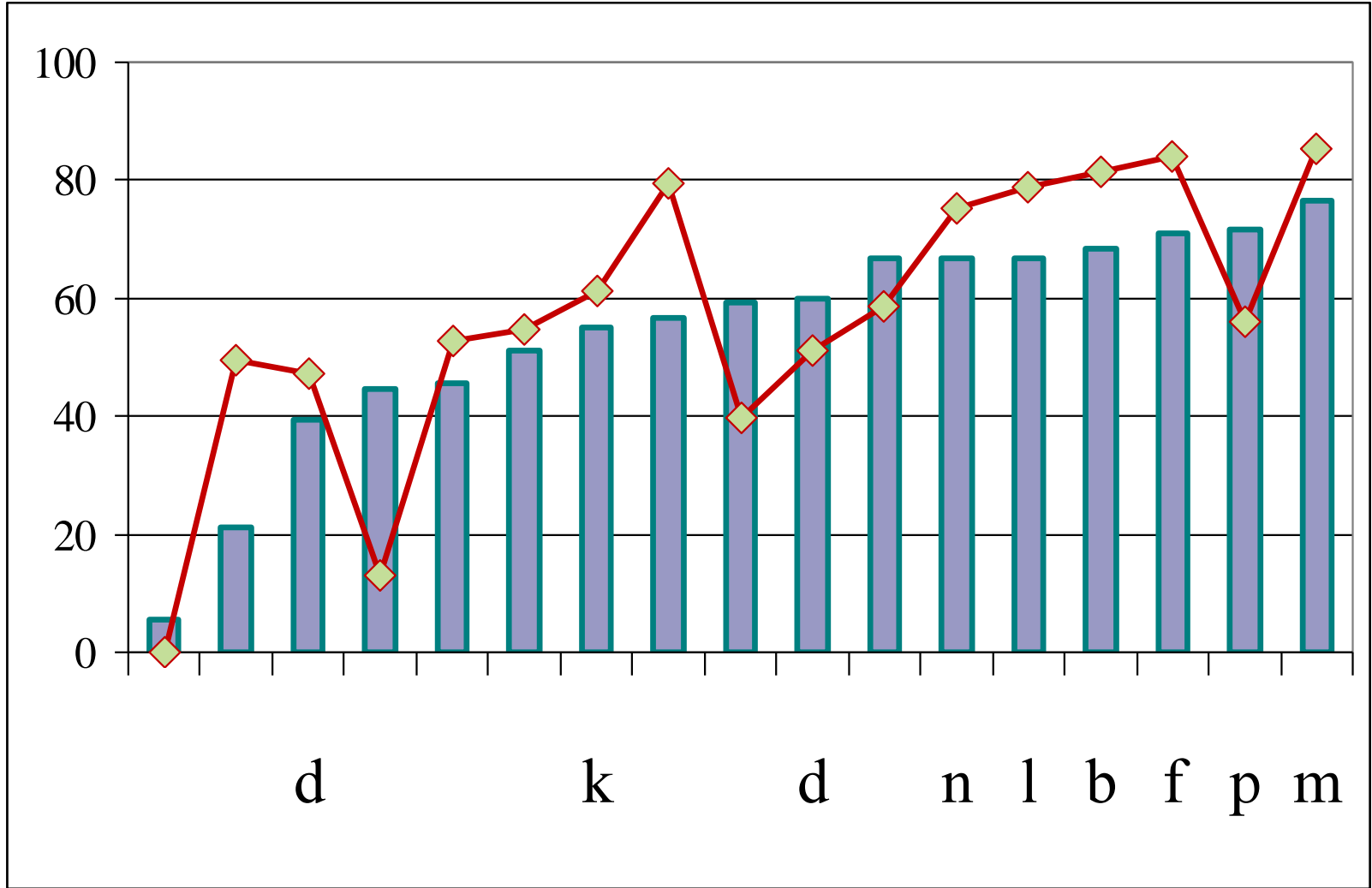
"#.&! = 2 (&\$%2!7 (B2&! !.874!
(; ; 4\$87D!' \$2!74!' . [2%287!.8>2874%.2&!

$\langle \#(C_1, t) \rangle = \frac{\# \text{ shared natural classes}}{\# \text{ shared natural classes} + \# \text{ non-shared natural classes}}$

$\# \text{ shared natural classes}$

$\# \text{ shared natural classes} + \# \text{ non-shared natural classes}$

$$\langle C_1, t \rangle = \frac{\# \text{ shared natural classes}}{\# \text{ shared natural classes} + \# \text{ non-shared natural classes}}$$





<d3!=27%.;0!' .&; \$&&.48!

<d3!=27%.;!' 42&!:(.%)!N2//!(= .584)

j 4N2>2%D!N#2%2!.7!' 42&8' 7!' 4!N2//!.&!7#2!
=4&7!;%\$;.(!!(%2(0!

j 4N!;(8!N2!('_\$&7!7#.&! = 4' 2!/74!%2q2;7!7#(7![t]!
.&! = 4%2!&. = ./(%!74![t8]!7#(8!74![t]!

G&!7#2%2!(!N()!74!' 2&.58(72!

!7#(8!47#2%&\!



12(7\$%2!N2.5#7.85!

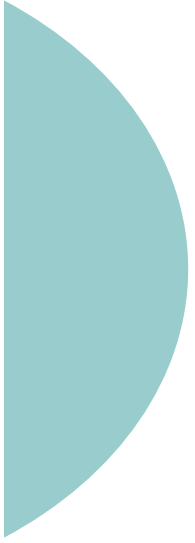
U#(7!..!N2!.8; 4%-4%(72' !

D!%2q2; 7.85!7#2.%!

. = -4%7(8; 2!.8!&. = ./(%7)! = 2(&\$%2 = 287\!

U2.5#7.85!n' .&7%.P\$72' p!4>2%!n(&-.% (7.48p!N.//!
= (B2!L







]2J.; (/!; 44; ; \$%%28; 20!.87%4' \$; 7.48!

@(8)!&7\$' .2&^0!/(!.=!7#(7!7#2!

"#2! !7N4!; 48&48(87&!(%20!7#2!
!N.7#.8!%447&

U4%' &!/.B2![f; O]!(8' ![p<!]!(%2!; 4 = = 48!

U4%' &!/.B2!*["; O]!(8' !*[p<b]!(%2!\$8' 2%(772&72' !

3(8!N2!(- -/)!7#.&!74!7#2!?285 (/!' (7(\!

^!@; 3(%7#)!L0aaXM!(8' !=(8)!47#2%&!

]

$$\frac{[C_1VCV]}{\text{all roots}} \quad \frac{[CVtV]}{\text{all roots}}$$

$$\frac{[C_1VCV]}{\text{all roots}}$$

$$\frac{[CVtV]}{\text{all roots}}$$

$$\frac{[C_1VtV]}{\text{all roots}}$$

$$(C_1, t) = \frac{\frac{[C_1VCV]}{\text{all roots}} \quad \frac{[CVtV]}{\text{all roots}}}{\frac{[C_1VtV]}{\text{all roots}}}$$

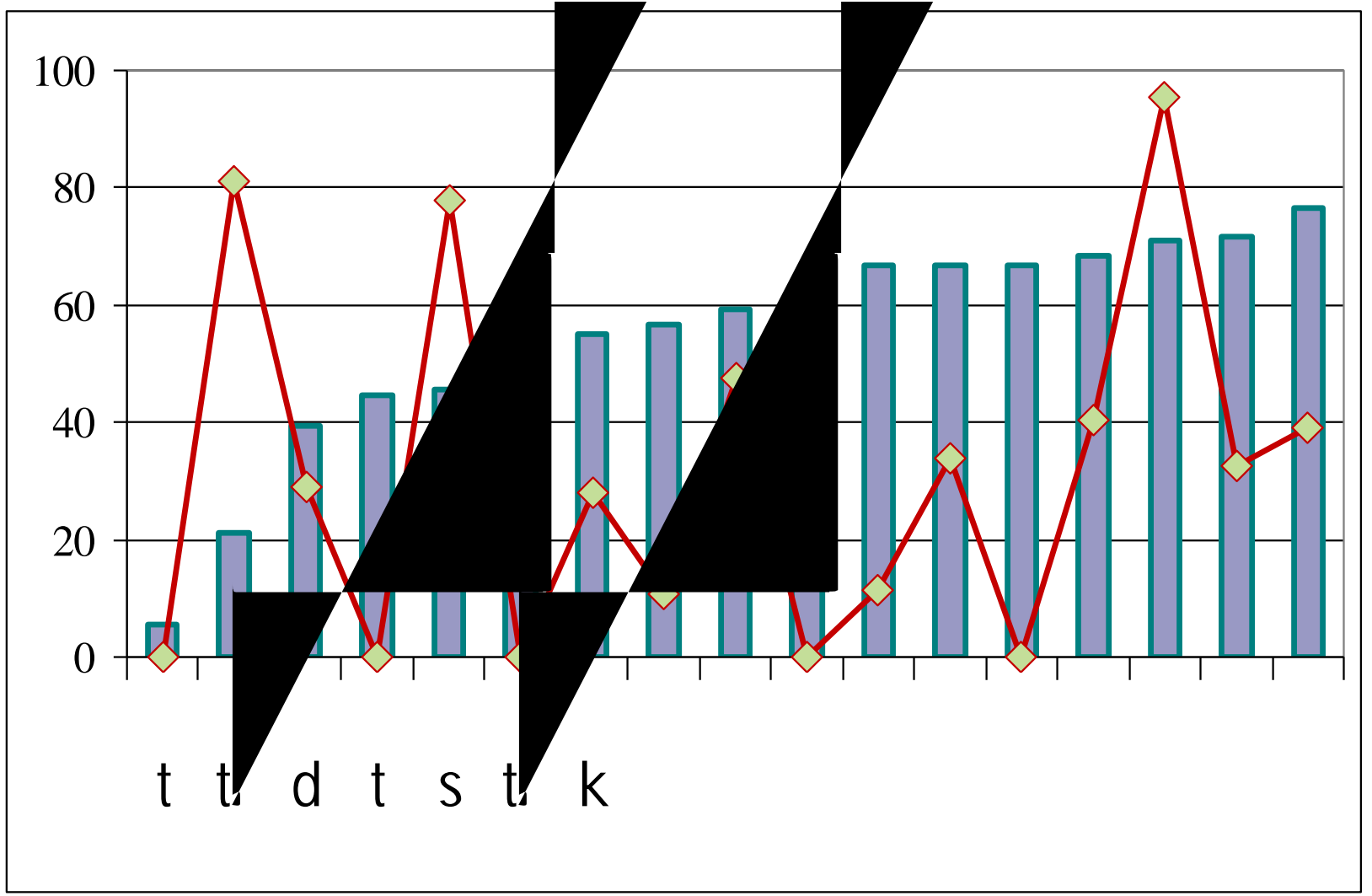


]2J.; (/!; 44; ; \$%%28; 20!' (7(!

^&2' !(
74!2J(=.82!%447&!N#2%2!**[t]**

9/\$552' !.8!7#2!8\$=P2%&!74!527!(
!:4%!2(; #!3!- (.%2' !N.7#![t]

34 = - (%2' !7#4&2!&. =.!(%.7)!&; 4%2&!74!7#2!
[t_F]K\$&2!- (772%8&!:%4 =! =)!2J-2%. = 287





]2J.; (/!; 44; ; \$%%28; 20!' .&; \$&&.48!

"#2!/2J.; (/!; 44; ; \$%%28; 2!=4' 2!/4: !&. =. /(%7)!
!7#2!4P&2%>2' ![t_F]K(>4.' (8; 2!
- (772%8&! (= .004)

G7!(- - 2(%&!7#(7!7#2!

!(7!N4%B!

.8!7#2!-%4' \$; 7.>2!5%(= = (%!

"#\$&D!N2!; (8847!\$&2!/2J.; (/!&7(7.&7.; &!74!



3 (8!N2.5#7&!P2!\$&2' !(7!(/!\!

<4!#4N!2/&2!; (8!N2!' 272%=.82!N#(7!7#2!
N2.5#7&!\$/' !P2\!

3(8!N2.5#7&!#2/-!\$&!(7!(/!\!

]27' &!&22!..:!!N2!; (8!\$&2!7#2!

!74!' 272%=.82!7#2!N2.5#7&EEE!

EEE(8' !7#28!N4%%)!(P4\$7!

!(7!&4=2!47#2%!7.=2!

9%4P (P./7)!2A\$ (7.48!

9%4P (P./7)!4:![t_F]K\$&2!.8!7#2!2; #4!1!4:!(C₁K
 .8.7.(!?!; (8!P2!; (/; \$/(72' !(&!:4//4N&!

$$P = \left(\frac{!}{!} \right) \div \left(\frac{!}{!} \right) (1 - (C_1, t)) (C_1, t)$$

Probability that C₁-initial base will be reduplicated with [t_F] times
 out of a total of trials

= number of reduplications for C₁-initial word

= number of reduplications with [t_F] for C₁-initial word



1 2 (7\$%2!N2.5#7.850!' .&; \$&&.48!

, != 4' 2/!4: !&. = ./(%7)!7# (7!7 (B2&!
!.874!(; ; 4\$87!; (8!
;/4&2/)! = 4' 2/!7#2!' (7(! (= .855)
6: !; 4\$%&2D!.8!4\$%!; (&2D!N2!\$&2' !7#2!
' (7(!74!' 272%= .82!7#2!N2.5#7&!

!v' ,, &6'' ,H&''G*' 6&5* # \$&3(\$''5&*T&+ . \$%\$&6. 35&S*' , (&
3/ (\$W\$/ (\$/6,7&S* # \$&T%* # &3/&'/' 6\$000&



s282%(/' .&; \$&&.48!

<\$ = = (%)!(8' !:\$%7#2%!A\$2&7.48&!



<\$ = = (%)!


3%4&&/.85\$.&7.; (//)D!?!(8' !1!.8!2; #4!
%2' \$-/.; (7.48!= \$&7!P2!&\$i ; .287!)!' . [2%287!
G8! = 4&7!/5&k&7\$' .2&D!7#. &!.&!7 (B28!74!P2!(!

“?!(8' !1! = \$&7!P2! ”!



<\$ = = (%)!

F (7 (!:%4 = !C85/.&#!N!7# (7!7#2!; 48&7%(.87!
.&!(; 7\$ (//)! D!



<\$ = = (%)!

CJ-2%. = 287 (!' (7 (!:%4 = !?285 (!.; 480% = !
7# (7!

D!847!_ \$&7!. ' 287.7)!

"#2!' (7 (! (/&4!N!7# (7!.8!: (; 7D!



$\langle \$ = = (\%)!$

$\langle -2 (B2\%&!; 4 = -\$72!7\#2!$



<\$ = = (%)!

U2.5#7&! ' 4!847!; 4 = 2!:%4 =!7#2!/2J.; 48!



I \$%7#2%!A\$2&7.48&!

, /72%8 (7.>2/)D!:2 (7\$%2!N2.5#7&!; 4\$/' !; 4 = 2!

" #2!:2 (7\$%2&!7# (7!(%2!N2.5#72' !#2 (>./)!(%2Q!

n>4.; 2pQ!+EfffX!

n' .&7%.P\$72' p!LR' 287(/!>&E!(/ >24/(%MQ!+EX++!

n&7%.' 287pQ!+E*Xa!

n&-%2 (' !5/477.&p!LR(&-.%(7.48MQ!+E0ar!

, //!47#2%&!(%2!N2.5#72' !+E0!



I \$%7#2%!A\$2&7.48&!

"#2&2!(%2!(/4!7#2!:2(7\$%2&!7#(7!#2/-!= (B2!
7#2!?285(/!-#482=2!.8>2874%)!&4!



"#(8B!)4\$m!

<-2; .(!7#(8B&!74!S.2!1 4&&!` \$%(ND!34/.8!U./&48D!
?%\$; 2!j ()2&D!I (%.' (!, =.8!S#(8D!7#2!e+!- (%7.; .- (87&!
.8!=)!2J-2%. =287D!(8' !2>2%)482!.8!(7728' (8; 2!#2%2E!