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-"(%a:(*()'+%&')-*()b%7F49%8'*':#*:%'%32*;%G"#/"%#$%(*;.G(;%0,%-"(%a+#8#-(;%&')-*()$b%
7Y4$9N%!"(%Y4$%78'#*+,%#*$-#-2-#.*'+%#*1($-.)$%'*;%G('+-",%#*;#1#;2'+$9%/.88#-%-.%&).1#;(%
'%/()-'#*%'8.2*-%.3%/'&#-'+%-.%-"(%32*;N%!"(%F4%-"(*%"'$%'*%':)((;%-#8(%&()#.;%#*%G"#/"%
-.%#*1($-%7').2*;%S%,(')$9%'*;%#*%G"#/"%-.%)(-2)*%/'&#-'+%-.%-"(%Y4$%72$2'++,%').2*;%VWc
VR%,(')$9N%5'/"%32*;%.)%+#8#-(;%&')-*()$"#&?%-"()(3.)(?%#$%($$(*-#'++,%'%/+.$(;%(*;%32*;%
G#-"%'%3#*#-(%+#3(N%!"(#)%#++#62#;#-,%'*;%-"(%3'/-%"'-%'/-2'+%&).3#-'0#+#-,%#$%.*+,%;%#$/+.$(;%'-%
-"(%(*;%.3%-"(%32*;d$%+#3(%)'#$($%-"(%#$$2(%.3%".G%-.%8('$2)(%-"(%&()3.)8'*/(%.3%&)#1'-(%
(62#-,%#*%-()8$%.3%#-$%&).3#-'0#+#-,%7'*;%'+$.%".G%-.%;(3#*(%'*%'&&).&)#'-(%0(*/"8')Q%-.%
'$$($$%G"(-"()%#-%,#(+;$%+'):()%)#$Q%';e2$-(;%'1()':(%)(-2)*$%-"'*%-)';(;%$(/2)#-#($9N%@%
$-'*;');%&).3#-'0#+#-,%8('$2)(%.3-(*%2$(;%-.%'$$($$%&).3#-'0#+#-,%)(+'-#1(%-.%/.$-$%'*;%
(<&(*$($#$%)(-2)*%.*%'$$(-$%7B f@9?%G"#/"%#$%;(3#*(;%'$%*(-%&).3#-%.)%*(-%#*/.8(%7'3-()%'++%
/.$-$?%(<&(*$($%'*;%-'<($9%;#1#;(;%0,%-.-'+%'$$(-$N%%

H')#.2$%&'&()$%"'1(%#*%3'/-%&).1#;(;%(1#;(*/(%.*%-"(%&).3#-'0#+#-,%.3%&)#1'-(%(62#-,%
1#$PgP1#$%;#33()(*-%0(*/"8')Q$%7$((?%(N:N?%4"'+#&&.2%'*;%F.--$/"'+:?%RWWT?%'*;%I./")'*(?%
RWWS9N%\.G(1()?%*.*(%.3%-"(8%"'1(%(<'8#*(;%-"(%$-./"'$-#/%&).&()-#($%.3%&)#1'-(%(62#-,%
)(-2)*$%3.)%'%G#;(%)'*:(%.3%/.2*-)#($%'*;%#*1($-8(*-%-,&($%'*;%2$#*:%'%:(*()'+%(8&#)#/'+%
3)'8(G.)Q%-"'-%(*/'&$2+'-($%'%1')#(-,%.3%&.$$#0+(%$-./"'$-#/%0("'1#.2)$N%!"(%&)($(*-%
$-2;,%'#8$%-.%/.*-)#02-(%-.%-"(%(<#$-#*:%+#-()'-2)(%#*%-".$(%-G.%)($&(/-$N%X.)(%$&(/#3#/'++,?%
#-%'*'+,$($%;'-'%3.)%3.2)%$&(/#3#/%')('$%7=>?%52).&(?%@$#'A4'/#3#/%'*;%B($-%.3%-"(%C.)+;9%%
'$%G(++%'$%-"(%a!.-'+b?%'*;%3.)%$(1(*%#*1($-8(*-%-,&($%7D2,.2-%E%F).G-"%562#-,?%H(*-2)(%
I'&#-'+?%J2*;%.3%J2*;$%E%>(/.*;'),%J2*;$?%K*3)'$-)2/-2)(?%L'-2)'+%B($.2)/($?%B('+%
5$-'-(?%>20.);#*'-(;%I'&#-'+%E%M#$-)($$(;9?%'$%G(++%'$%-"(%'::)(:'-(%/'-(:.),%a@++%

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$#:*#3#/'*-+,N%B.::#%(-%'+N%7RWVT9%.0-'#*(;%$#8#+')%)($2+-$^%-"()(%#$%*.%3'$-%#*/)('$(%#*%32*;%
&()3.)8'*/(%2*-#+%'%/()-'#*%32*;%$(62(*/(%#$%)('/"(;?%'*;%-"(%8'):#*'+%#*/)('$(%#*%-"(%
$(62(*/(%*280()%$((8$%-.%&).;2/(%&.$#-#1(%(33(/-$%.*%32*;%KBB%'*;%4X5?%(1(*%'-%'"#:"%
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@$%3.)%-"(%0("'1#.2)%.3%45%&).3#-$%.1()%-#8(?%@*:%(-%'+N%7RWVZ9!*.-(;%-"'-%+#8#-(;%
;'-'%'1'#+'0#+#-,%8'Q($%#-%&')-#/2+')+,%;#33#/2+-%-.%(1'+2'-(%-"(#)%-#8(%$()#($%&).&()-#($0%
".G(1()?%#-%'&&(')$%-"'-%-"(%/,/+($%.3%45%)(-2)*$%3.)%$(&')'-(%/+'$$($%.3%H(*-2)(%I'&#-'+?%
D2,.2-?%'*;%B('+%5$-'-(%')(%*.-%"#:"+,%/.))(+'-(;N%!"#$%$2::($-$%-"'-%'-%;#1()$#3#(;%$-)'-(:,%
'/).$$%$20P'$$(-%/+'$$($%.3%45%8',%0(%0(*(3#/#'+N%X.)(.1()?%45%)(-2)*$!(<"#0#-$%*(:+#:#0+(%
$()#'+%;(&(*;(*/(?%#*%/.*-)'$-%-.%#*;2$-),%#*;#/($N%!"#$%)($2+-%#$%/.*$#$-(*-%G#-"%-"(%

VU! **" ;ES=G=**9**=8F!**

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E%F).G-"%562#-,?%>20.);#*'-(;%I'&#-'+%E%M#$-)($$(;?%L'-2)'+%B($.2)/($?%B('+%5$-'-(?%K*3)'$-)2/-2)(?%J2*;%.3%J2*;$%E%>(/.*;'),%J2*;$?%'*;%@++%!,&($9%!"(%$'8&+(%&()#.;%1')#($%;(&(*;#*:%.*%-"(%:(.:)'&"#/'+%')('%'*;%-"(%#*1($-8(*-%-,&(^%#-%(*;$%#*%'++%/'$($%#*%RWRVp[%02-%-"(%$-')-#*:%;'-(%#$%VTZVpR%#*%$.8(%/'$($%'*;%+'-()%#*%.-"()$%78.)(%;(-'#+$%')(%&).1#;(;%#*%!'0+(%V9%c%#*%-.-'+%-"(%$'8&+(%#*/+2;($%`?VS`%.0$()1'-#.*$

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&)(/#$(+,?%-"(%($-#8'-(;%8.;(+%#$^%

%%%%%%%% % % $y = \beta + \beta\, t + x\,;(1-B)\;x = u\;\; t = 1,2,\ldots$ % % 7[9%

C(%)(&.)-%-"(%($-#8'-($%.3%-"(%;#33()(*/#*:%&')'8(-()%;%3.)%-")((%$&(/#3#/'-#.*$^%#9%

.%;(-()8##$-#/%/.8&.*(*-$?%#N(N?%$(--#*:%r)%'*;%r!%(62'+%-.%W%#*%56N%7[90%##9%'%/.*$-'*-%

.*+,?%#N(N%r!%o%W%'*;%r)%0(#*:%3)((+,%($-#8'-(;0%###9%0.-"%r)%'*;%r!%0(#*:%3)((+,%($-#8'-(;%

3).8%-"(%;'-'%-.:(-"()%G#-"%;N%K*%('/"%/'$(%'&)(3())(;%8.;(+%#$%$(+(/-(;%.*%-"(%0'$#$%.3%

-"(%$#:*#3#/'*/(%.3%-"(%)(:)($$.)$N%K*%';;#-#.*?%G(%'$$28(%-"'-%-"(%()).)%-()8%2$%#*%7[9%

3.++.G$%(#-"()%'%G"#-(%*.#$(%&)./($$%7!'0+(%`9%.)%'*%'2-./.))(+'-(;%.*(%7!'0+(%j90%#*%-"(%

+'--()%/'$(?%G(%2$(%-"(%(<&.*(*-#'+%$&(/-)'+%'&&).'/"%.3%D+..83#(+;%7VTh[9?%G"#/"%#$%*.*P

&')'8(-)#/%#*%-"(%$(*$(%-"'-%#-%;.($%*.-%)(62#)(%-.%$&(/#3,%'%32*/-#.*'+%3.)8%3.)%2$%02-%.*+,%

#-$%$&(/-)'+%;(*$#-,%32*/-#.*?%G"#/"%#$%1(),%$#8#+')%7#*%+.:$9%-.%-"(%.*(%&).;2/(;%0,%@B%

$-)2/-2)($N%J#*'++,?%:#1(*%-"(%62')-()+,%3)(62(*/,%.3%-"(%;'-'?%'%$('$.*'+%@B7V9%&)./($$%#$%

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/'$($%#*%3'1.2)%.3%+.*:%8(8.),%7;%q%W9%.)%3)'/-#.*'+%#*-(:)'-#.*?%-"(%($-#8'-(;%1'+2(%.3%;%

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I.*/()*#*:%-"(%)($2+-$%0,%'$$(-%/+'$$%0'$(;%.*%-"(%$'8(%G"#-(%*.#$(%'$$28&-#.*?%

-"(%-#8(%-)(*;%#$%$#:*#3#/'*-%3.)%aK*3)'$-)2/-2)(b%7KLJB9%#*%-"(%!.-'+%'*;%-"(%=>@%'*;%

'+$.%3.)%aL'-2)'+%B($.2)/($b%7LB5>9%'*;%a>20.);#*'-(;%I'&#-'+%E%M#$-)($$(;b%7>IEM9%

#*%52).&(N%K*%-"(%3#)$-%-G.%/'$($?%-"(%-#8(%-)(*;%/.(33#/#(*-%#$%&.$#-#1(%G"#+(%#-%#$%*(:'-#1(%3.)%-"(%-G.%52).&('*%'$$(-%/+'$$($%7$((%!'0+(%S%-"'-%)(&.)-$%-"(%($-#8'-(;%/.(33#/#(*-$%.3%-"(%$(+(/-(;%8.;(+$9N%@$%3.)%-"(%1'+2($%.3%;?%8.$-%.3%-"(8%')(%$#:*#3#/'*-+,%&.$#-#1(?%G"#/"%$2&&.)-$%

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+.*:%8(8.),%2*;()%-"(%'$$28&-#.*%.3%D+..83#(+;%()).)$?%-"#$%0(#*:%3.2*;%.*+,%3.)%J.J%
#*%-"(%!.-'+%7G#-"%;%o%WN``9%'*;%#*%52).&(%7WN`h90%LB5>%#*%-"(%!.-'+%7WNR[90%B>!@!5%7#*%
-"(%!.-'+?%WNjS^%=>@?%WNhT?%'*;%52).&(%'*;%-"(%B($-%.3%-"(%C.)+;?%WN[j90%'+$.%#*%KLJB%
3.)%-"(%=>@%7G#-"%;%o%WN[h9%'*;%3#*'++,%3.)%HI@4%7-"(%!.-'+?%WN`j?%'*;%-"(%=>@?%WN`T9N%
J#*'++,?%G"(*%'%$('$.*'+%@B%&)./($$%#$%'$$28(;%3.)%-"()).)$%7!'0+($%Z%'*;%T9?%
-"(%)($2+-$%')(%1(),%$#8#+')%-.%-".$(%0'$(;%.*%G"#-(%*.#$(%()).)$%7!'0+($%`%'*;%S9^%-"()(%
')(%.*+,%-")((%$()#($%3.)%G"#/"%-"(%-#8(%-)(*;%#$%$-'-#$-#/'++,%$#:*#3#/'*-%7KLJB%#*%-"(%!.-'+%
'*;%-"(%=>@%'+.*:%G#-"%>IEM%#*%52).&(?%#*%-"(%+'--()%/'$(%G#-"%'%*(:'-#1(%/.(33#/#(*-9N%
51#;(*/(%.3%$".)-%8(8.),%.)%K7W9%0("'1#.2)%#$%3.2*;%3.)%KLJB%#*%'++%)(:#.*$?%02-%'+$.%3.)%
'++%.-"()%'$$(-%-,&($%(</(&-%J.J%'*;%B>!@!5%#*%52).&(N%K*%:(*()'+?%B>!@!5%'*;%HI@4%
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VTZ[9?%'*;%-"(%+./'+%C"#--+(%($-#8'-#.*%'&&).'/"%.3%]s*$/"%7VTZh9%7!'0+(%VW9N%K*%0.-"%
/'$($?%'%0'*;G#;-"%&')'8(-()%$&(/#3,#*:%-"(%*280()%.3%J.2)#()%3)(62(*/#($%82$-%0(%
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F . 8 &()$?% 4N@N?%] . 1*()% @N?% Y()*()?% tN% '*;% >/"')3$-(#*?% MN% 7RWWS9N% H(*-2)(% I '&#-'+%
K*1($-8(*-%I , /+($^%!"(%K8&'/-%.3%420+#/%X')Q(-N%LD5B%C .)Q#*:%4'&()%*.N%VV[ZS?%RWWSN%
"--&^AAGGGN*0()N.):A&'&()$AGVV[ZS%
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F . 8 &()$?%4N?%] . 1*()?%@N?%Y()*()?%tN?%E%>/"')3$-(#*?%MN%7RWVW9N%4()3.)8'*/(%&()$#$-(*/(%
#*% (*-)(&)(*(2)$"#&N% t.2)*'+% .3% J#*'*/#'+% 5/.*.8#/$?% Tj7V9?% VZc[RN%
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F . 8 &()$?% 4N?% F .)*'++?% CN?%] '&+'*?%>N% LN?% E%>-)(02+'(1?%KN%@N% 7RWRV9N% \ .G% H(*-2)(%
I '&#-'+#$-$% X'Q(%M(/#$#.*$%@*%#*$#;(%+..Q%'-%'*%.&'62(%&)./($$N% \ ')1');%02$#*($$%
)(1#(G?%TT7R9?%hWPlN%
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\ '))#$?%BN%>N?%t(*Q#*$.*?%!N?%] '&+'*?%>N%LN?%E%>-2/Q(?%BN%7RWRW9N% \ '$%&()$#$-(*/(%&()$#$-(;%
#*%&)#1'-(%(62#-,w%51#;(*/(%3).8%02,.2-%'*;%1(*-2)(%/'&#-'+%32*;$N% 7L.N% GRZVWT9N%
L'-#.*'+%D2)('2%.3%5/.*.8#/%B($(')/"N%
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\ '$$+()?%=N?%E%C .+-()$?%tN%7VTT`9N% f*%-"(%&.G()%.3%2*#-%)..-%-($-$%':'#*$-%3)'/-#.*'+%
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4"'+#&&.2?% Y?% E% F.--$/"'+:?% f% 7RWWT9% !"(% 4()3.)8'*/(%.3% 4)#1'-(% 562#-,% J2*;$%
B(1#(G%.3%J#*'*/#'+%>-2;#($?%RR7`9?%Vh`hcVhhj%"--&$^AA;.#.):AVWVWT[A)3$A""*WV`%
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	;<"=!	PEACFG!	?EPFFG!	HEFBHG!	PEHDA!	P?ECBH!
	JKLM!	PEFBIG!	PEHNBG!	DEHIIG!	@IEDPB!	NEPCN!
	)<K7!	?ECA?G!	PEIDHG!	PEHN?G!	@BEDHI!	HEFFF!

:)"!

O6M)!

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>20.);#*'-(;%I'&#-'+% WNRW%%%7PWNWV?%%WN`j9% **QUTZ!!!`KQUQTA!!QUWVa!** WNV[%%%7PWNWZ?%%WN`[9% E%M#$-)($$(;%

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J2*;%.3%J2*;$%E% >(/.*;'),%J2*;$%	WNRV%%%7WNWS?%%%WN`R9%	WNWRhVW%%%7VNT[9%	PPP%

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- > I 9 ; ! b 4 ! % D E : < > E ; D ! = L ! G ! I > D ; G ! = B ! > 7 E = N = ? ? ; 9 > E ; G ! / 9 = = < L : ; 9 G ! ; ? ? = ? D !

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> ( ) # ($ %	L . % ; (- ( ) 8 # * # $ - # / % - ( ) 8 $ %	@ * % # * - ( ) / (& - %	@ * % # * - ( ) / (& - % ' * ; % ' % % + # * (') % - # 8 (% -) (* ; %
@ + + % ! , & ($ %	W N [W % % % 7 W N W V ? % % W N h R 9 %	**Q U P [! ! ! ` Q U Q T A ! ! Q U Z T a !**	W N [W % % % 7 W N W ` ? % % W N h V 9 %
D 2 , . 2 - % E % F) . G - " % 5 6 2 # - , %	W N R ` % % % 7 P W N W Z ? % % W N j S 9 %	**Q U P P ! ! ! ` K Q U Q [A ! ! Q U b] a !**	W N R S % % % 7 P W N W ` ? % % W N j R 9 %
J 2 * ; % . 3 % J 2 * ; $ % E % > (/ . * ; ') , % J 2 * ; $ %	**Q U W W ! ! ! ` Q U Q] A ! ! Q U \ W a !**	W N ` V % % % 7 W N W S ? % % W N T ` 9 %	W N ` j % % % 7 W N W Z ? % % W N T ` 9 %

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B('+%5$-'-(%	**QUVb!!!`QUQ]A!!QUZ\a!**	WN[`%%%7WNW`?%%WNZV9%	WN[S%%%7PWNW[?%WNZV9%
>20.);#*'-(;%I '&#-'+% E%M#$-)($$(;%	PWNRj%%7PWN`W?%%WNRW9%	PWNV`%%7PWN[ [ ?%%WNV`9%	**KQUWb!!`KQUZTA!!QUQPa!**
H(*-2)(%I '&#-'+%	WNVR%%%7PWNRW?%%WNS[9%	**QUTT!!!`KQUT\A!!QU]Va!**	WNWT%%%7PWNRV?%%WNS[9%

>$23_!2;3!0/-(3*!)0!Y$-8!5$##3*9$08!2$!2;3!*3-35238!*935)%)5/2)$0!$0!2;3!Y/*)*!$%!2;3!*2/2)*2)5/-!*)10)%)5/053! $%!2;3!8323#:)0)*2)5!23#:*&!W;3!5$0%)83053!)023#0/-*!/2!2;3!I\e!-303-!/#3!#39$#238!)0!Y#/5632*&!

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@++%!,&($%	WNRZ%%%7WNWV?%%WNhV9%	WNWRT[%%%7RNVh9%	PPP%
D2,.2-%E%F).G-"% 562#-,%	WNRR%%%7PWNWZ?%%WNjS9%	WNW[SRh%%%7[NWW9%	PPP%
J2*;%.3%J2*;$%E% >(/.*;'),%J2*;$%	WN``%%%7WNWS?%%WNT`9%	PPP%	PPP%
K*3)'$-)2/-2)(%	PWNWj%%7PWN[W?%%WNRS9%	PWNWW`hW%%%7PVNj`9%	WNWWW`V%%%7RNjh9% %
L'-2)'+%B($.2)/($%	WNR[%%%7WNW[?%%WNS[9%	WNWRjSh%%%7RN`j9%	PPP%
B('+%5$-'-(%	WNjS%%%7WN[[?%%VNVV9%	PPP%	PPP%
>20.);#*'-(;%I'&#-'+% E%M#$-)($$(;%	PWNR`%%7PWN``?%%WNWS9%	WNWRjjh%%%7RjNV`9%	PPP%
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J2*;%.3%J2*;$%E% >(/.*;'),%J2*;$%	%WNV[%%7PWNRZ?%%WNhW9%	WNWRhST%%%7RNhW9%	%
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D2,.2-%E%F).G-"% 562#-,%	WNRT%%%7WNVj?%%WN`j9%	QUP\!!!`QUTbA!!QUWba!	WNRT%%%7WNVj?%%WN`j9%
J2*;%.3%J2*;$%E% >(/.*;'),%J2*;$%	QUW[!!!`QUV]A!!QUbVa!	WN`h%%%7WN[[?%%WNj[9%	WN`Z%%%7WN[S?%%WNj`9%

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D2, .2-%E%F).G-"% 562#-,%	WNVV%%%7PWNWV?%%WNRj9%	WNW[[TR%%%7RNTR9%	PPP%	WNWST%
J2*;%.3%J2*;$%E% >(/.*;'),%J2*;$%	WNRV%%%7WNWS?%%WN`V9%	WNWRhWV%%%7VNZS9%	PPP%	PWNWjV%
K*3)'$-)2/-2)(%	WNWT%%%7PWNWT?%%WN[R9%	WNW[h``%%%7RNWZ9%	PPP%	PWNWRT%

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L '-2)'+%B($.2)/($

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	F4\%5$-#8'-(%	Y./'+%C"#--+(% 5$-#8'-(% >-'*;');%()).)%

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->I9;!TT4!%DE:<>E:=B!=L!G!I>D;G!=B!.+,'" .!!

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