

!  
!  
!  
!  
!  
!  
!  
!  
!  
!  
!

— ! "#\$%&'()\*+,-./01(

!

!

!

!

!

"#\$%&'&()(\*'+\$, (%!-#(!.%(/.0, (%%11/!%#' 213!)'-(%!-1!+('%.)(!-#(!+1, (-')4!&10\$54!%-', 5(!64!51+&')\$, 7!-#(+!-1!-#(!1//\$5\$'0!&10\$54!)'-(%!', 2!-#1%(!\$+&0\$(2!64!-#)(!-4&(%!1/!

!

!

!"#\$%&'()\*+,-.:/0#&/'"\$1%\*2)3#2)4#/#5/6%\$1''%\$%\*'#)\$'%\*#/'#''%)\$78%\$/#5%3%5\*#)"4#  
'/#)4/9'#,"&/'3%'1/'")5#-%)\*,\$%\*#/#-1'1:)'%#2%#1-9)&#/'0#2%#;5/. )5#<1'"&1)5#=\$1\*1\*#)"4#/0#  
'2%#=/3147>?#9)"4%-1&#/'#01'"&1)5#-\$@%\*'#)"4#2%#%&/' / - (#)\*#)#62/5%A#B\*#)#\$%\*,5'+#1'#2)\*#

!

!

#

!

!

1"3%\*1:)'%4# '2%# %00%&'13% "%\*\*# /0# , "&/'"3% "'1/'")5# - /"%')\$(#9/51&1%\*# , "4%\$#)# .1"41":# FEO#  
&/'\*\*'\$)1" '#, \*1":#1 - %73)\$('":#&/%001&1%"'#VBW#- /4%5\*#/0#2%#\*2)4/ 6#)\$'%#1 - 951%4#. (#'2%#C)(5/\$#  
\$,5%\*A#a%#0/ , "4#2)'#2%#\*2)4/ 6#)\$'%#1\*#)#, \*%0,5#1"41&)'/\$#/0#2%# - /"%')\$(#9/51&(##') "&#)"4#2)'#  
'2%#\*%"\*1'131'(# /0#%&/'/ - 1&#0, "4) - %"'')5\*# '/#\*2)4/ 6#)\$'%#\*2/&@\*#2)\*# \$ - )1"%4# , "&2)":#4#  
4,\$1":#2%#FEO#9%\$1/4+#6215%#2)'#/0#; bU#:\$/6'2#)"4#1"05)'1/'#/'#<%4%)5#0, "4\*#)\$'%#\*2/&@\*#  
2)\*#1"&\$%)\*%4A##

#

!\*#2/ ,54# .%# "/%4#2)'#2%\$%#)\$%#4100%\$%"#9/\*1.5%#6)(\*#/'#\*1-)'%#\*2)4/6#)\$'%\*+#'2%#2\$%#  
-/\*'#&/ - - /"5(#, \*%4#/'%\*#. %1":#2\$%#70)&/'\$%#\$ - #'\$',&', \$%# - /4%5\*#GP ,#)"4#c1)+HI>dK+#'6/7  
0)&/'\$#)001"%#%\$ - #'\$',&', \$%# - /4%5\*#GQ\$199"%\$+HI>[)K+#)"4#4(" - 1&#0)&/'\$# - /4%5\*#GE/ - .)\$41#  
)"4#F2, +HI>JK#C2%#)3)15).5%#% - 91\$1&)5#%314%"&#\*# , ::#'\*#\*2)'#2%#6/70)&/'\$# - /4%5\*#9\$/4, &%#  
'2%#\*2)4/6#)\$'%\*# - /\*'#&5/\*%5(#'\$)&@1":#2%#/001&1)5#9/51&(##)\$'%#)"4#9\$/314%#2%# - /\*'#)&&,\$)'%#  
)\*\*%\*# - %"'#/0#2%# - /"%')\$(#9/51&(##')"&%

!

!

$$p$$

$$S_t = \sum_{i=1}^p \beta_i S_{t-i} + \epsilon_t$$

#

62%\$%# / #1\*2%#& / %001&1% " ' - ) '\$ID# / "#9)\*'5) : \*# / 0# '2%#0)& / \$\*A#M1" &%# . / '2#&\_t#) "4#0\_t#)\$%#)\*\* , - %4#  
 ' / # . % #232343#) "4# ; ) , \*\*1) " + '2%#4(" - 1&#0)& / \$# - / 4%5#&)"# . % #6\$1'%"#1"#) #\*)' ) %7\*9)&%#0 / \$ - #) "4#  
 %\* '1 - )' %4# 61'2# '2%#Q)5 - )" #015'\$A# T& / " / - 1&#3)\$1) .5%\*# )\$%# \*%5%&' %4#0\$ / - #) #5)\$ : % #4)' ) \*% '# / 0#  
 - / "%') \$( #9/51& (#1"41&)' / \$\*# ' / # / . ') 1"# '2%#0)& / \$\*A#C2%# - / 4%5#1\*# '2%"#%\* '1 - )' %4# 61'2# '2%# ] , ) \*1#  
 - )D1 - , - #51@%512 / / 4#G^ e EK#%\* '1 - )' / \$# . ) \*%4# / "#'2%#%D9%&') '1 / "# - )D1 - 1\*)' 1 / "#GT e K#)5 : / \$1'2 - #  
 9\$ / 9 / \*%4# . (#b / 8#%'#)5A#GHI>HKN#'21\*#1\*#\*1 - 15)\$# / #)' #6 / 7\*%'9#%\* '1 - )' / \$# . , '# , \*%\*#)#Q)5 - )" #015%'\$1" : #  
 9\$ / &%4 , \$%# 621&2# 1\*# 1%'\$)' %4# , "'15# T e # & / "3%\$ : % "&%# 1\*# )&21%3%4# )"4# 1\*# \$ / . , \*# '# / # - / 4%5#

:!

!

!

HI>JK+#6215%# '2%#& / %001&1% "'\*# / "#'2%#1"05)'1 / "#)"4# / , '9, '#: )9\*#) \$%# ) : )1"#\*% '#% ] , )5# / # (3; #) "4#<3; #  
\$%\*9%&'13%5(A#<1" )55(+ #6%#& / "\*14%\$#)#C) (5/\$#\$ , 5%#61'2#1"'%\$%\*'#\$)'%#\* - // '21" :X#

!

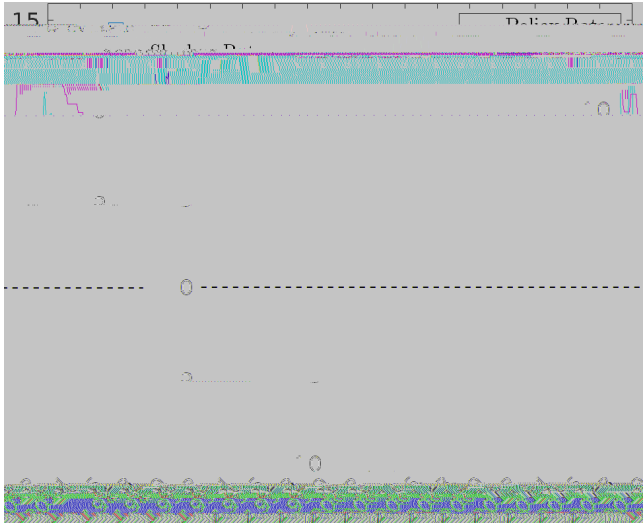
;!



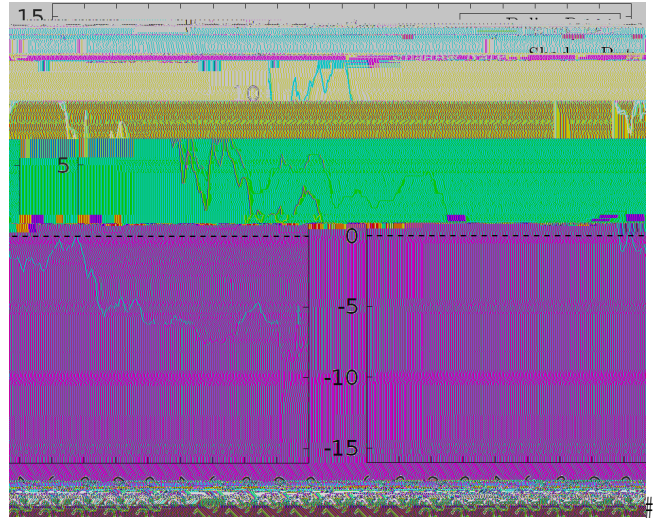


!

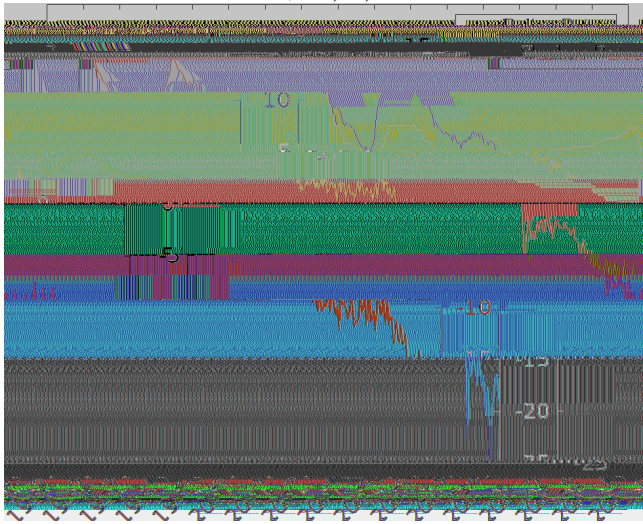
LQ#



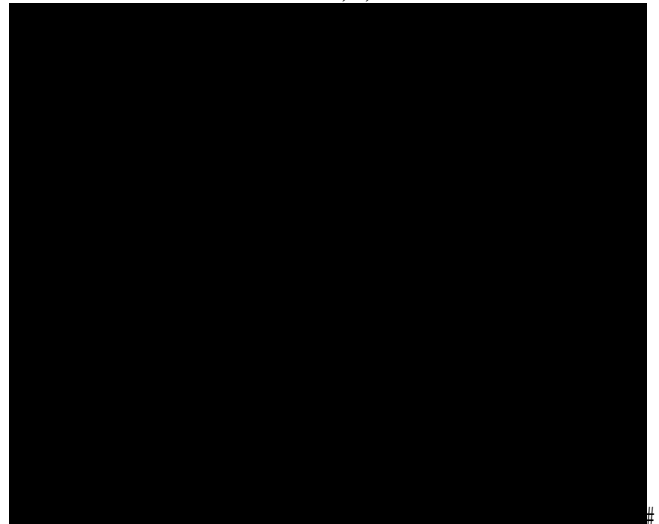
=) ")4)#



B, \*'\$)51)#



R% 6#F%)5)"4#



<1: , \$%#>#)"4#H#41\*95)(#2%#%\*1 - )'%4#\*2)4/ 6#\$)'%\*# / : %'2%\$# 61'2#2%# /001&1)5#9/51& (# / "%\*#1"'2%#  
 1"05)'1/"#')\$:%'1" : #&/ , "'\$1%\*#)"4#2%#" / "7')\$:%'1" : # / "%\*#%9%&'13%5(A#!'#&)"# . %#\*%#"#2)'#2%#  
 \*2)4/ 6#\$)'%#\$)&@\*#2%# /001&1)5#9/51& (#\$)'%3%\$(#&5/\*5(#4, \$1" : #'2%#" / "7FEO#9%\$1/4#1"'2%#&)\*%#  
 /0#=#)4)#R% 6#F%)5)"4+#2%#T, \$/#B%)#)"4#M61'8%\$5)"4+#. , '#5%\*#&5/\*5(#1"#)55# / '2%\$#&/ , "'\$1%\*A#  
 !"#&/"#\$)\*#/#E/ - .)\$41#)"4#F2, #GHI>JK# 62/#0/& , %\*4# / "#2%#LM# / "5(+6%#01"4#2)'#\*2)4/ 6#  
 \$)'%#\*2)3%#\$)&@4#2%#9/51& (#\$)'%\*5%\*#&5/\*5(#\*1"&#2%#%)\$5(HIII\*#1"# - /\*#&/ , "'\$1%\*X# '2%#  
 0/\$ - %\$#)\$%# . ) \*4# / "#) - , &2#614%\$#)" : %# / 0#9/51& (#1"41&)' / \$\*+6215\*#'2%#5)''%\$4# / "#)'&& , \$)'%5(#  
 \$%9\$%\*"# '2%#0, 55\$)" : %# / 0#9/51& (#&'1/"\*#')@#"# . (#&%"\$)5# . )"@\*A#!"#9)\$'l& , 5)\$+4, \$1" : #FEO#

=!

!

!

9%\$1/4\*+ # \*2)4/6# \$)'%\*# ', \$"# "% :)'13%# 0/\$# )55# &/ , "'\$1%\*+ # )\*# '2% (# \$%05%&'# '2%# 0,55# \$)" :%# /0# , "&/"3%"'1/"')5# - /"%')\$(# '\*1 - ,5, \*# - %)\*, \$%\*# )4/9%'4# . (# &% "'\$)5# . )" @\*# 4, \$1" :# '2%# ;5/ . )5# <1" )" &1)5#=\$1\*1\*#)"4# '2%# = /3147>?#9)"4% - 1&A#C2%1\$# . %2)31/ , \$#1 - 951%\*# '2)'# '2%# - /"%')\$(#\*')"&%# 6)\*#1"#0)&'# - , &2#5// \*%\$# '2)"#1"41&)"%4# . (# '2%# /001&1)5#9/51&(#\$)'%+ # %3%"#1"# '2%#&/ , "'\$1%\*# '2)'# )55/6%4#1"'%\$%\*'#\$)'%\*#'/# . %&/ - %#" "% :)'13%+ #1A%A#S)9)" + # '2%#T, \$/#B\$%)#)"4#M61'8%\$5)"4A##

LM#

S)9)"#

T, \$/7B\$%)#

M61'8%\$5)"4#

>!

!

!

#

LQ#

=)"4)#

#

#

B, \*'\$)51)#

R% 6#F%)5)"4#

#

#

; 13%"# '2)'#)55#&/ , "'\$1%\*#1"#'2%#\*) - 95%#2)3%#%1'2%\$#)4/9'%4#)"#1"05)'1/"#')\$:%'1":#\$%:1-%#/\$#)'#  
5%)\*'#')\$:%'4#2%#1"05)'1/"#\$)'%#)'#1-%\*+1#1\*#1"'%\$%\*'1":#/#&/-9)\$%#1"%)&2#&)\*%#2%#)\$)'%#1-951%4#  
.(#'2%#C)(5/\$#\$,5%#'/#./'2#2%#/001&1)5#)"4#2%#\*2)4/6#)\$'##'/#)\*%\*#2%#-/'".2(\*)-0.2(#)25.6(')0.2/21%RIT.

6?!

!



!

R%D'6%#)\*\*%\*#2%#,%0,5"\*#/#0#\*2)4/6#)\$'%\*#/#)"5(\*%# - /"%')\$(#9/51&(#\*2/&@\*A#<1:,\$%#[#)"4#  
d#4!\*95)(#'

!

!

!

!

LQ#

LM#

#  
#

#

#

!





!

<\$/(% "# WACA# )"4# ; ,%"4%\$+# BAV# HI>JA# C2%# \$%)5# %D&2)" :%# \$)'%# 1"# C)(5/\$# \$,5%\*X# B# W%7  
B\*\*%\* - %"A# # #99A>ZI7>[>A#

; %5)&2# MA# )"4# M&2").%5# ; A# HIIA# C2%# C)(5/\$# \$,5%# )"4# 1"'%\$%\*'# \$)'%\*# 1"# '2%# T e L#  
)\$%)A# # GHK+#99A>d[7>g>A#

a)551"# e A# )"4# E1f@)#WA+# HIIgA# b%'\$ - 1"1" :# '2%# " , - .%\$#/0#0)&'/\$\*#1"# '2%# :% "%\$)5#4(") - 1&#  
0)&'/\$# - /4%5A# # GZgJK+#99AdIY7d>gA#

a /4\$1&@+# WASA# )"4# US%\*&'"+# TA=A+# >?#gA# U/\*'6)\$# LM# . ,\*1"%\*# &(&5%\*X# )" # - 91\$1&)5#  
1"3%\*1:)'1/"A# #99A>7>dA#

Q\$199"%\$+#EA#GHI>[)KA# #R 1 X#  
U)5:\$)3%7 e )& - 155)"A#

Q\$199"%\$+#EA#GHI>[.KA#B#&/ - - %"'#/"# P ,#)"4# c1)#GHI>[K#)"4#'2%#&)\*%#0/\$# '6/70)&'/\$#\*2)4/6#  
\*2/\$'#\$)'%\*A# =% "'\$%#0/\$# B9951%4# e )&\$/%&/' / - 1&#B")5(\*1\*+# =B e B# P /\$@1" :#U)9%\$#ZJjHI>[+#  
B ,\*\$)51)"#R)'1/" )5#L"13%\$\*1'(A#

E/ - .)\$41+# e ASA#)0.24#\$%#0/\$# B9951)0.24#\$ - 6(\$%)0.2(#)>0.2(42(A(\$#)( / - )0.2(.))0.2(\$41)0.2(+)#29.2(e )

!

!

P ,+#SA=A#)"4#c1)+#<AbA+#HI>dA#e%)\*,\$1":#'2%# - )&\$/%&/' / - 1&#1 - 9)&'#/0# - /"%')\$(#9/51&(#)'#2%#  
8%\$/#5/ 6%\$#. / , "4A# # GH7YK+#99AH[Y7H?>A#

P ,+#SA=A#)"4#F2)":+#SA+#HI>?A#B#\*2)4/ 6#\$)'%#R% 6#Q% ("%\*1)"# - /4%5A#  
# #9A>IYgHJA#

#

#

!

!

!

T\*1 - )'1/ "#1 - %#9%\$1/4#0/\$#%)&2#&/, "'\$(X#

L"1%4#Q1":4/ - # =)"4)#	S)", )\$(#>?Jd# S)", )\$(#>?Jd#	b%&% - .%\$#HIH># b%&% - .%\$#HIH>#	B9\$15#HII?#i#e )(#HI>IN# e )\$&2#HIHI#i#b %&% - .%\$#HIH># B, : , *'#HI>d#i

!

!''#\$%&'() (

\*+,+(-./,(0#(\*1\$+ 2&3(4+3,./ ( 5 .%#6(

78 9\$&,#%( : &\$;% . 2 (

			!
"#\$%&'()*+!	&,-./0!120-3!"4!567!(0.,!	20-3!48!/%-./-0.54-0!9,..1, : , -.;!	<0.=/0!14>0/5.? : !
@ABC!	DE F 4-.?!*/ ,0;= /7!25!1!	20-3!48!+ ->!0-G!	<0.=/0!14>0/5.? : !
@AC!	HE F 4-.?!*/ ,0;= /7!25!1!	20-3!48!+ ->!0-G!	<0.=/0!14>0/5.? : !
I!	IE ' ,0!*/ ,0;= /7! (0.,!	20-3!48!+ ->!0-G!	<0.=/0!14>0/5.? : !
B!	BE ' ,0!*/ ,0;= /7! (0.,!	20-3!48!+ ->!0-G!	<0.=/0!14>0/5.? : !
D!	DE ' ,0!*/ ,0;= /7! (0.,!	20-3!48!+ ->!0-G!	<0.=/0!14>0/5.? : !
C!	CE ' ,0!*/ ,0;= /7! (0.,!	20-3!48!+ ->!0-G!	<0.=/0!14>0/5.? : !
J!	JE ' ,0!*/ ,0;= /7! (0.,!	20-3!48!+ ->!0-G!	<0.=/0!14>0/5.? : !
I@!	I@E ' ,0!*/ ,0;= /7! (0.,!	20-3!48!+ ->!0-G!	<0.=/0!14>0/5.? : !
F@!	F 4-. ,0/7!20; ,!	20-3!48!+ ->!0-G!	' ,0/E4-E7,0!>/4K.?!/0.,!
F I!	F 4-,7!9=LL!7!F I!	# +&M!	' ,0/E4-E7,0!>/4K.?!/0.,!
F B!	F 4-,7!9=LL!7!F B!	20-3!48!+ ->!0-G!	' ,0/E4-E7,0!>/4K.?!/0.,!
F D!	F 4-,7!9=LL!7!F D!	# +&M!	' ,0/E4-E7,0!>/4K.?!/0.,!
* )!	*4.0! ) ; ; ,. ; !	20-3!48!+ ->!0-G!	N5; .!G588, / , -6, ; !
*9!	*4.0!9,6= /5.5, ; !O, !G!# =. /5>? .!	20-3!48!+ ->!0-G!	N5; .!G588, / , -6, ; !
M9!	M, P. !9, 6= /5.5, ; !	20-3!48!+ ->!0-G!	N5; .!G588, / , -6, ; !

<8 =+\$+%+(

>8 !?@,+6&+(

			!
"#\$%&'()*+!	&,-./0!20-3!"4!567!(0.,!	20-3!84/!%-./-0.54-0!9,...1, : , -.;!	<0.=/0!14>0/5.? : !
@!BC!	DE F 4-.?!*/ ,0;=/7!25!1!	( ; , /Q, !20-3!48! ) =; ./0!50!	<0.=/0!14>0/5.? : !
@!C!	HE F 4-.?!*/ ,0;=/7!25!1!	( ; , /Q, !20-3!48! ) =; ./0!50!	<0.=/0!14>0/5.? : !
I!	IE ' ,0!*/ ,0;=/7! (0.,!	( ; , /Q, !20-3!48! ) =; ./0!50!	<0.=/0!14>0/5.? : !
B!	BE ' ,0!*/ ,0;=/7! (0.,!	( ; , /Q, !20-3!48! ) =; ./0!50!	<0.=/0!14>0/5.? : !
D!	DE ' ,0!*/ ,0;=/7! (0.,!	( ; , /Q, !20-3!48! ) =; ./0!50!	<0.=/0!14>0/5.? : !
C!	CE ' ,0!*/ ,0;=/7! (0.,!	( ; , /Q, !20-3!48! ) =; ./0!50!	<0.=/0!14>0/5.? : !
J!	JE ' ,0!*/ ,0;=/7! (0.,!	( ; , /Q, !20-3!48! ) =; ./0!50!	<0.=/0!14>0/5.? : !
I@!	I@E ' ,0!*/ ,0;=/7! (0.,!	( ; , /Q, !20-3!48! ) =; ./0!50!	<0.=/0!14>0/5.? : !

A8 B#C(D#+6+\$%(

		!	
"#\$%&'()*+! @ABC!	&,-./0!20-3!"4!567!(0.,! D	20-3!84/!%-.,/-0.54-0!9,..1,:,-.;!	<0.=/0!1!4>0/5.? : !

E8 9 \$&,#%(F,+,#@()

			!
"# \$%&' ( ) * +!	&, - ./0!20-3!"4!567! (0.,!	20-3!84/!%-./-0.54-0!9,..1, : , -.;!	<0.=/0!14>0/5.? : !
@!ABC!	DE F 4-.?!*/,0;=/7!25!1!	N,G,/0! ( , ; ,/Q,!20-3!48!9.!\$4=5;!	<0.=/0!14>0/5.? : !
@!C!	HE F 4-.?!*/,0;=/7!25!1!	N,G,/0! ( , ; ,/Q,!20-3!48!9.!\$4=5;!	<0.=/0!14>0/5.? : !
I!	IE ',0048-3 (/) -2 (Q,-2 (0)042/) -3 (=) -2 (/) -3 (0) -2 (!) -		



G8 H+''+\$(

**I8 J?/.K!/#+(**

L8 FC&,M#/6+\$%(