Global Population Projections: A critical analysis of key methods and assumptions

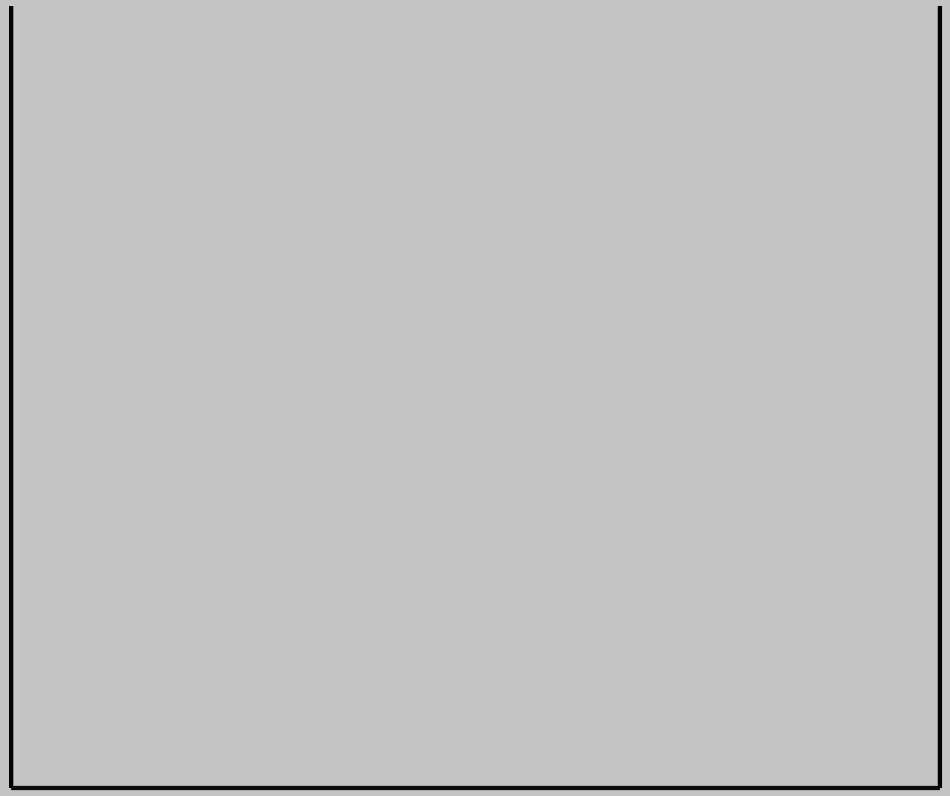
Brief history of UN projections

- FH%5.*5%"I%1"12(3*'"$%1-"?./*'"$5+%.4.-J%F%"-%K%J.3-5 5'$/.%<=L<
- 63-(J%1-"?./*'"$5%M.-.%I"-%*#.%M"-(:%"-%(3-D.%-.D'"$5%"$(J
- 0-"?./*'"$5%I"-%'$:'4':23(%/"2$*-'.5%C.D'$$'$D%'$%<=HE
- FG<=%.:'*'"$%'$/(2:.5%1-"?./*'"$5%I-") %FGFG%*"%F<GG I"-%FKL%/"2$*-'.5%"-%3-.35

Methods and assumptions of UN projections

- N"-.%3552) 1*'"$5%3C"2*%I2*2-.%*-.$:5%D-"2$:.:%'$%
- O-3$5'*'"$%*#."-J%-.I(./*.:%'$%
- 6$#3$/.) .$*5%:2.%*"%
  - A"-.%-.('3C(.%-.52(*5%I"-%/"2$*-'.5P3-.35%M'*#%(.55%-.('3C(.%:3*3%"-%3*%.3-('.-%5*3D.5%"I%*-3$5'*'"$
  - 0-"4':.5%1-"C3C'('5*'/%355.55) .$*%"I%3(*.-$3*'4.%I2*2-.%*-.$:5

Classic model of demographic transition



Three phases of TFR trend: Pre-decline, decline and post-decline

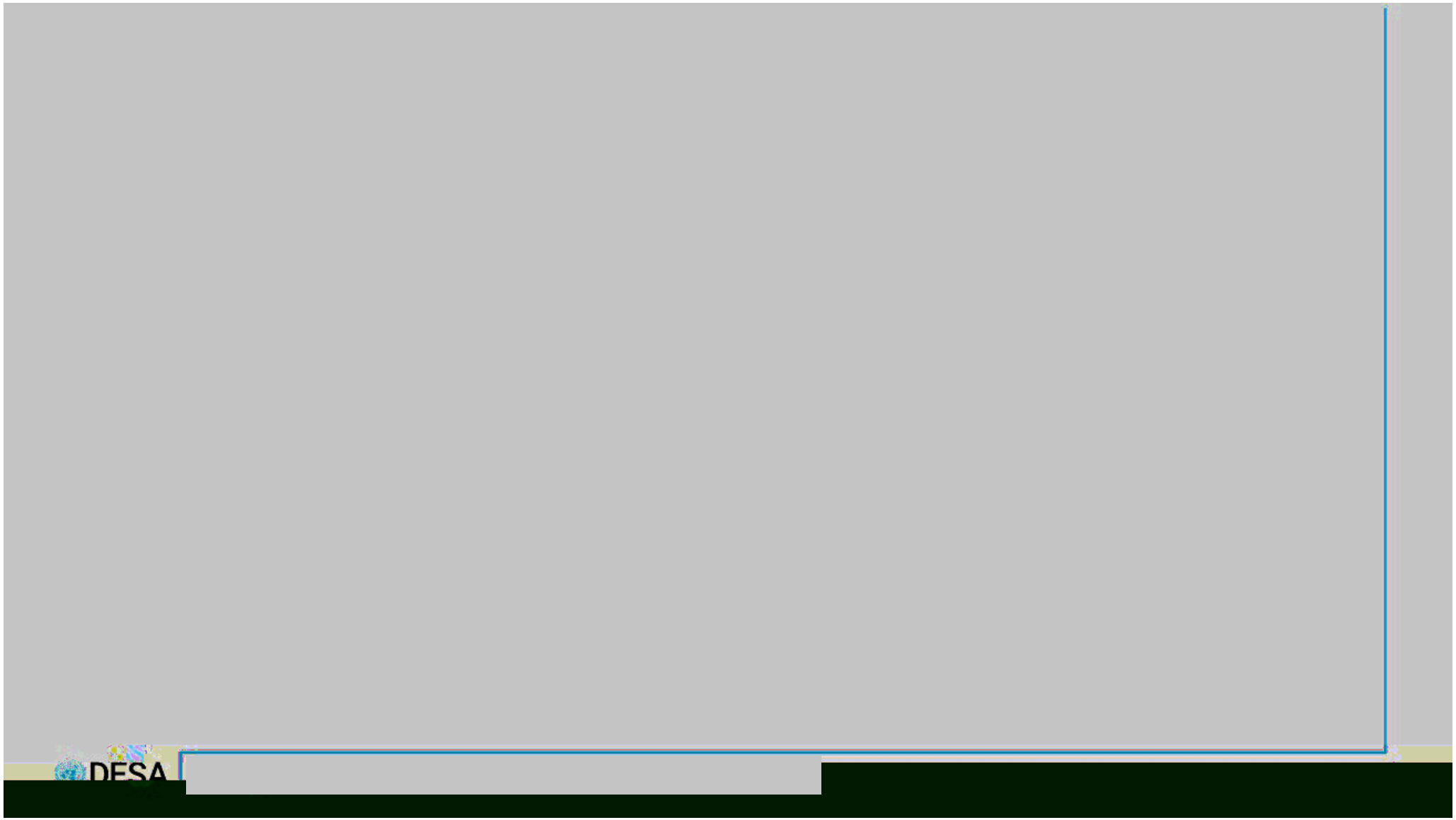
Model of historical trend in life expectancy at birth


DESA

Projected global population 2015-2100

UN and IIASA projections

- &#3*%3-.%*#.%S.J%:'II.-.$/.5T
- U"M%*"%.V1(3'$%*#.%:'II.-.$/.5T
- W.D'$%CJ%/") 13-'$D%) .:'2) %1-"?./*'"$5


DESA

>O#'5%:'II.-.$/.%'5%) "5*(J%:2.%*"%:'II.-.$*%) .*#":5%
"I%:.-'4'$D%("$DX*.-) %I.-*'('*J%3552) 1*'"$5%I"-%*#.%
:'II.-.$*%13-*5%"I%*#.%M"-(:+%M#.-. *#.%

Statistical extrapolation model of fertility decline

- ^"(.%"I%.V1.-*%3-D2) .$*5%3$:%5/'.$*'I'/%-.35"$'$D
- _$I"-) . :%CJ%:3*3%3$:%*#."-J+%'$/(2:'$D%*#."-'.5%"I% :.) "D-31#'/%*-3$5'*'"$
- O#-..%.V3) 1(.5@
  - 6V/(25'"$%"I%"C5.-43*'"$5%1-.X:3*'$D%) ":.-$%/"$*-3/.1*'"$
  - Z"$DX*.-) %) "-*3('*J%*-.$:5%'$I"-) . :%CJ%*-.$:5%'$%-./"-:%("$D.4'*J
  - 0"5*X:./('$.%I.-*'('*J%) ":.(%M.((%?25*'I'.:%CJ%:3*3%3$:%*#."-J

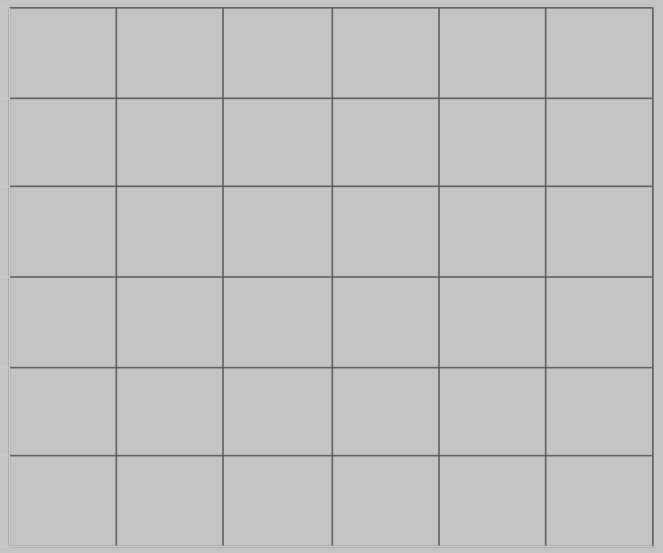
- 635*.-$%b%7"2*#%635*.-$%85'3
  - N#'$3
  - N#'$3%% U"$D%c"$D%78^
  - N#'$3%%


DESA

- 1-"?./*'"$+%C35.:%"$%#'5*"-'/3(%.V1.-'.$/.+%
  3//"2$*5%I"-%.:2/3*'"$3(%/#3$D.%
- 1-"?./*'"$+%C35.:%"$%.V1.-*%?2:D.).$*+%
  3//"2$*5%I"-%.:2/3*'"$3(%/#3$D.%
- "I%.:2/3*'"$3(%/#3$D.%'$%
  5.**'$D%3552)1*'"$5%I"-%*#.%).:'(")-1(-)4cmB(-$%02(6))1(?)9.(

>Z2*[%3$:%#'5%I.(("M%:.) "D-31#.-5%3*%d'.$$3j5%_$*.-$3*'"$3(%
_$5*'*2*.%I"-%811('.:%7J5*.) 5%8$3(J5'5%C.('.4.%*#3*%
+%C-"2D#*%3C"2*%
CJ%'$/-.35'$D%2-C3$'[3*'"$+%

Total fertility rate (TFR), Nigeria, 1950-2100



TFRs for African countries, IIASA vs. UN medium

`"-%8I-'/3$%/"2$*-'.5+%1-"?./*.:%).:'2)%O`^%43(2.5%
3-.%"$%34.-3D.%<Ek%("M.-%I"-%_878%/")13-.:%*"%9;%
\21%*"%QGk%("M.-%I"-%5")./"2$*-'.5]+%M'*#%5)3((.-%
-.(3*'4.%:'II.-.$/.5%CJ%F<GG

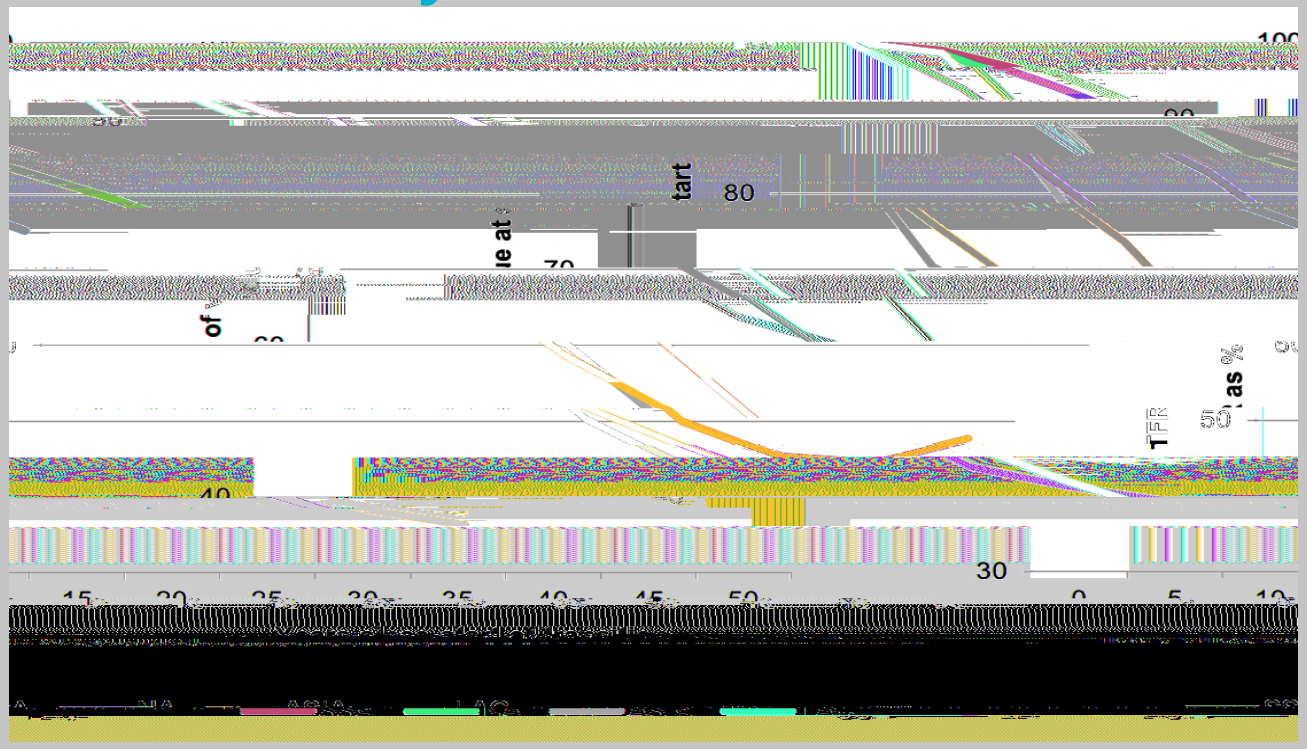
Critical assessment of two methodologies

- O-3/S%-./"-:%"I%9;%1-"?./*'"$5
- d3(':3*'"$%"I%1-"C3C'('5*'/%'$*.-43(5
- ^.('3C'('*J%"I%.V1.-*%1-.:'/*'"$5
- N"#.-.$/.%"I%_878%3(*.-$3*'4.%5/.$3-'"5
- 8//.(.-3*.:%I.-*'('*J%:./('$.%I"-%8I-'/3
- 8DD-.D3*'"$%"I%3(*.-$3*'4.%5/.$3-'"5

UN 2010 out-of-sample validation: 1990-2010

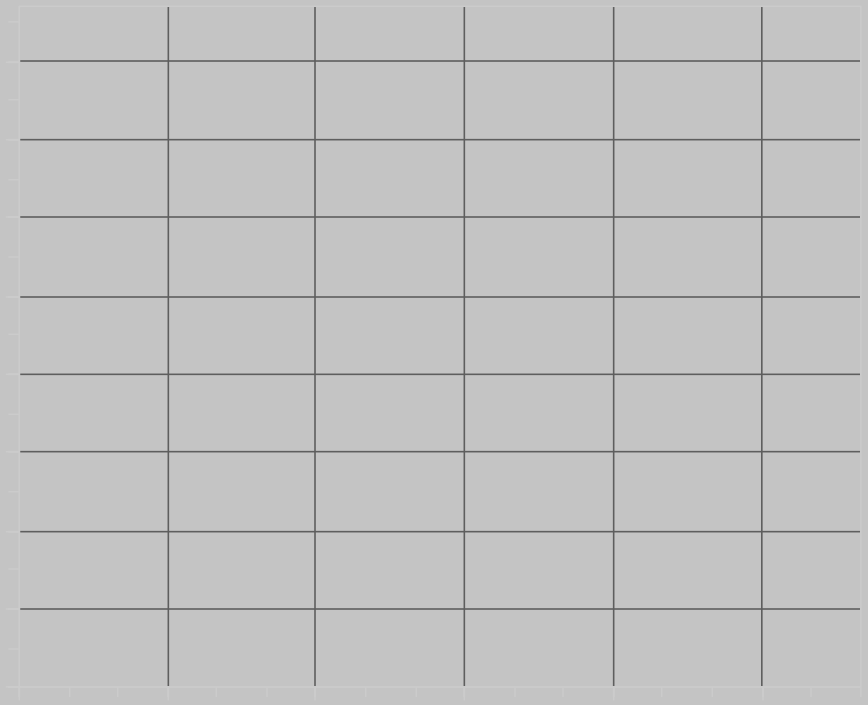
89#56:6;	<=>?&2@7	-./%0#1%&23%04%567 A+@&30%B:46:.5& :56%0/#C	DE@&30%B:46:.5& :56%0/#C
?(',"&@).'#"#'1&.,')	57<8	27	32
A)B,")&"#@)&)CD)$',E$1	7<6	38	49
+,")&"#@)&)CD)$',E$1	7<:	38	45
?(',"&D(D/",'#(E	7<2		

Plausibility of accelerated fertility decline in Africa



7#31'-"%3$:%U'$:.+%,.) "D-31#'/%^.5.3-/#+%FG<R+%1Y%<KKQ

Global population trend 2015-2100



- ^.(3*'4.(J%5) 3((%:'II.-.$/.5%C.*M..$%9 ;%3$:%_878%1-"?./*'"$5%'$%*#.%5#"-*%*"%) .:'2) %*.-)
- Z3-D.-%:'II.-.$/.5%'$%*#.%("$D%-2$%3-.%/"$5.n2.$*'3(%I"-%/(') 3*.%

!

) ' 4 I ' ' O#7% : O4*2 ' <# I 24 / #<2 (23 ; *#C ' (%B* ; 9 / 27#7%OC242%O<J##N / ' #Y ; E ' <2 ; O# (%C ' 3# ; 3<%#B ' O ' * ; 4 ' <# 9*%) ;) 232<427#9* ' C2742%O#2O4 ' *& ; 3<#4 / ; 4#C ' 9274#4 / ' #32F ' 32 / %%C#%>#; 34 ' *O ; 42& ' #> : 4 : * ' #4* ; L ' 74%*2 ' <J#

Y ' >%* ' #4 / ' #A$#C ' & ' 3%9 ' C#24<#9*%) ;) 232<427#9*%L ' 742%O# (%C ' 35#24#>%33% I ' C#4 / ' #7% ((%O#9* ; 7427 ' #%># B ' O ' * ; 42OB# / 2B / # ; OC#3% I #<7 ' O ; *2%<J##H9 ' 72>27 ; 33E5#4 / ' < ' # I ' * ' # / 2B / W# ; OC#3% I W> ' *42324E#& ; *2 ; O4<5# 7% (9 : 4 ' C#2O#4 / ' #<; (' # (; OO ' *# ; <#4 / ' # (' C2 : (#& ; *2 ; O4# I 24 / #%O3E# ; #< (; 33#7 / ; OB ' #2O#4 / ' #> ' *42324E# ; << : (942%OT##4 / ' #N]G# I ; <# ; << : (' C#4%#) ' # / 2B / ' *#%*#3% I ' *#) E# / ; 3>#%>#; #32& ' #) 2*4 / #>%*# ' & ' *E#7% : O4*E# %*# ; * ' ; # ; OC#>%*# ' & ' *E#E ' ; *#2O#4 / ' #> : 4 : * ' J#

N / 2<#B* ; 9 / #7% (9 ; * ' <#4 / ' #A$X<#4* ; C242%O ; 3# / 2B / W# ; OC#3% I W> ' *42324E#& ; *2 ; O4<#4%#4 / ' #9* ' C2742%O# 2O4 ' *& ; 3<#%>#4 / ' #9*%) ;) 232<427# ; 99*% ; 7 / J## 1 ' #<' ' #4 / ; 4#4 / ' < ' # / 2B / # ; OC#3% I #<7 ' O ; *2%<# ; * ' #R : 24 ' # ' Z4* ' (' # ; 4#4 / ' #B3%) ; 3#3 ' & ' 3J##N / ' # ' Z93 ; O ; 42%O#2<#<2 (93 ' T## I / 23 ' #24# (; E#) ' #93 ; : <2) 3 ' #4%# ; << : (' # ; # N]G#4 / ; 4#2<# / 2B / ' *#%*#3% I ' *#) E# / ; 3>#%>#; #32& ' #) 2*4 / #>%*# ; #B2& ' O#7% : O4*E#2O# ; #B2& ' O#E ' ; *5#4 / ' # ; << : (942%O#4 / ; 4# ; 33#7% : O4*2 ' <#2O# ; 33#E ' ; *<# I 233# / ; & ' # ; #> ' *42324E#3 ' & ' 3#4 / ; 4#2<# / 2B / ' *#%*#3% I ' *#) E#4 / 2<#

$'&'*4/'3'<<5#4/'#4I%#('C2:(#9*%L'742%O<#%>>'*#*;4/'*#C2>>'*'O4#&2<2%O<#%>#4/'#(%<4#32F'3E#
>:4:*'#4*'OC#%>#B3%);3#9%9:3;42%OJ##K

#=<#('042%0'C#';*32'*5#4/'#A$#>'*42324E#(%C'3#/;<#4I%#9;*4<5#7%**'<9%0C20B#4%#4/'#/2<4%*27;3#

C'732O'#>*%(#/2B/#4%#3%I#3'&'3<#U8/;<'#KKV

#

#N/2<# (2<:0C'*<4;0C20B#;)%:4#4/'#('4/%C<#:<'C#>%*#4/'#4I%#<'4<#%>#9*%L'742%0<#2<#I2C'<9*';C5#
;0C#24#/;<#9'*(';4'C#4/'#9%9:3;*#C2<7:<<2%05#;<#233:<4*;4'C#)E#4/2<#R:%4'#>*%(#;#*'7'04#)%%F#
73;2(20B#4/;4#;C&;0720B#'C:7;42%0#I%:3C#C*2&'#;#(%*'#*;92C#C'7320'#20#>'*42324E#4/;0#;042729;4'C#
20#4/'#A$#9*%L'742%0<J##K0#>;745#;3(%<4#'&'*E#42('#K#/;&'#/';*C#;#7%(9;*2<%0#%>#4/'#A$#;0C#KK=H=#
9*%L'742%0<5#4/2<#<;('#>;3<'#0;**;42&'#/;<#)''0#:<'C#4%#'Z93;20#4/'#C2>>'*'07'J#

K0#</%*45#3;C2'<#;0C#B'043'('05#K#'07%:*;B'#E%:#0%4#4%#;77'94#;#);<'3'<<#B'0'*;32S;42%0#;)%:4#;#
3;7F#%>#<72'042>27#*';<%020B#)E#A024'C#$;42%0<#C'(%B*;9/'*<5#%*#>;3<'#<4;4'('04<#;)%:4#4/'#
'Z932724#C*2&20B#>%*7'#%>#'C:7;42%0#20#4/'#KK=H=#('C2:(#9*%L'742%0J##K0<4';C5#3'4#:<#4*E#4%#
:0C'*<4;0C#I/;4#*';33E#:0C'*32'<#4/'#C2>>'*'07'#)'4I''0#4/'#4I%#<'4<#%>#9*%L'742%0<J###

K0#9:*'3E#('7/;027;3#4'*(<5#4/'#C2>>'*'07'#2<#C:'#9*2(;*23E#4%#C2>>'*'04#;<<:(942%0<#;)%:4#
>:4:*'#*;4'<#%>#7/;0B'#20#4/'#4%64;3#>'*42324E#*;4'J##N/2<#C2>>'*'07'#20#;<<:(942%0<#2<#'<9'72;33E#
2(9%*4;04#>%*#7%:04*2'<#%>#<:)WH;/;*;0#=>*27;5#I/'*'#(%<4#%>#4/'#I%*3CX<#>:4:*'#9%9:3;42%0#
B*%I4/#I233#4;F'#93;7'J###

#`'*'#2<#;0#233:<4*;42%0#>%*#;#<20B3'#7%:04*E5#$2B'*2;J##[0#4/'#3'>45#I'#<''#)%4/#4/'#:0C'*3E20B#C;4;#
9%204<#;0C#4/'#'#'<42(;4'C#&;3:'<#%>#4/'#C%:)3'#3%B2<427#(%C'35#>%*#4/'#('C2:(#<7'0;*2%#;0C#4/'#
:99'*#;0C#3%I'*#)%:0C<#%>#4/'#'#",W9'*7'04#9*'C2742%0#204'*&;3<J##[0#4/'#*2B/45#I'#<''#4/'#
9*%L'74'C#4*'0C#20#

#D ' 4# : <#O% I #3%%F#7*2427 ; 33E# ; 4#4 / ' #4 I %# (' 4 / %C%3%B2 ' <5#7%O<2C ' *2OB#) %4 / #4 / ' # ; 77 : * ; 7E#%>#* ' < : 34<#
; 0C#4 / ' #93 ; : <2) 2324E#%>#; << : (942%O<J#

#

7 : ** ' O43E# / ; &2OBJ##K4#2<# ; 3<%# ; 4#%CC<# I 24 / #C ; 4 ; #9* ' < ' O4 ' C# ' ; *32 ' *#< / % I 2OB#4 / ; 4# ; O# : 94 : *O#2O# > ' *42324E# / ; <#) ' ' O#R : 24 ' #7% ((%O#2O#< : 7 / #7% : O4*2 ' <J#

H ' 7%OC5# : OC ' *#4 / ' #HH8Q#<7 ' O ; *2%5#24#2<# ; << : (' C#4 / ; 4#4 / ' * ' # I 233#) ' #* ' 3 ; 42& ' 3E#3% I #3 ' & ' 3<#%># 2O4 ' *O ; 42%O ; 3# (2B* ; 42%OJ##g ' 45#2O# ; #>* ; B (' O4 ' C# I %*3C# I 24 / #*2<2OB#2O ' R : ; 324E5#4 / ' #9* ' << : * ' #>%*# 7*%<<W) %*C ' *# (2B* ; 42%O# I 233#* ' (; 2O# / 2B / J##K4#2<# : O73 ' ; *#2O#4 / 2<#7%O4 ' Z4# I / ' 4 / ' *#2O7* ' ; < ' C#< ' 7 : *24E# I % : 3C#) ' #< : >>272 ' O4#4%#32 (24# (2B* ; 4%*E#>3% I <J#

#=<#O%4 ' C# ' ; *32 ' *5# ; O#2 (93272 4# ; << : (942%O#%>#4 / ' #KK=H=# (' C2 : (#9*%L ' 742%O#2<#4 / ; 4#4 / ' * ' # I 233#) ' # ; # < :) <4 ; O42 ; 3# ; 77 ' 3 ' * ; 42%O#2O#4

D ; *B ' *#C2>> ' * ' 07 ' <#20#4 / ' #3%0B#* : 05# / % I ' & ' *5# ; * ' #7%0< ' R : ' 042 ; 3#>%*#C2<7 : <<2%0<#%>#732 (; 4 ' #7 / ; 0B ' # ; 0C#%4 / ' *# ' 0&2*%0 (' 04 ; 3#2 (9 ; 74<#%># / : (; 0# ; 742&242 ' <J## [0#4 / ' #%0 ' # / ; 0C5#%& ' *<4 ; 420B#32F ' 3E# >: 4 : * ' #4* ' 0C<#7% : 3C#) ' # : < ' C#4%#L : <42>E#7% ' *72& ' #9%3272 ' <J## [0#4 / ' #%4 / ' *# / ; 0C5# : 0C ' *<4 ; 420B#32F ' 3E# >: 4 : * ' #4* ' 0C<#7% : 3C#3 ' ; C#4%#7% (93 ; 7 ' 07E# ;) % : 4#4 / ' #B*% I 4 / #%># / : (; 0#7%0< : (942%0# ; 0C#C2 (2O2< / # 4 / ' #< ' 0< ' #%># : *B ' 07E# ;) % : 4#32 (2420B# ' 0&2*%0 (' 04 ; 3#2 (9 ; 74<#9 ' *#7 ; 924 ; J#

c %&20B#>%* I ; *C5#K# I 2< / #4%#9*%9%< ' #4 / ; 4#4 / ' #A$# ; 0C#KK=H=#4 ' ; (<#< / % : 3C# I %*F# (%* ' #73%< ' 3E# 4%B ' 4 / ' *#4%# : 0C ' *<4 ; 0C#) ' 44 ' *#4 / ' #<% : *7 ' <#%>#C2>> ' * ' 07 ' #20#4 / ' 2*#9*%L ' 742%0<#%>#B3%) ; 3# 9%9 : 3 ; 42%05#4%#9*%&2C ' # ; 77 : * ; 4 ' # ' Z93 ; 0 ; 42%0<#%>#C2>> ' * ' 07 ' <#20#4 / ' 2*# (' 4 / %C<# ; 0C#* ' < : 34<5# ; 0C#4%# ' 07% : * ; B ' #>* ; 0F# ; 0C#%9 ' 0#C2<7 : <<2%0<#%>#4 / ' #2 (9327 ; 42%0<#%>#9%9 : 3 ; 42%0#9*%L ' 742%0<#>%*#4 / ' # >: 4 : * ' # I ' 33W) ' 2OB#%>#4 / ' # I %*3C# ; 0C#24<#20 / ;) 24 ; 04<J##