

فصلنامه‌ی مطالعات اقتصاد انرژی / سال هفتم / شماره‌ی ۲۴ / بهار ۱۳۸۹ / صفحات ۸۹ - ۶۳

## مقایسه‌ی مدل لجیستیک و مدل‌های هاروی در پیش‌بینی مصرف برق ایران

محمد حسن فطرس

دانشیار دانشکده‌ی اقتصاد و علوم اجتماعی دانشگاه بوعلی سینا همدان [fotros@basu.ac.ir](mailto:fotros@basu.ac.ir)

حامد منصوری گرگری

کارشناس بررسی‌های اقتصادی بازار برق، برق منطقه‌ای آذربایجان [hamed.mansoori@gmail.com](mailto:hamed.mansoori@gmail.com)

تاریخ دریافت: ۸۸/۶/۲۳ تاریخ پذیرش: ۸۸/۱۱/۱۱

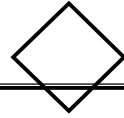
### چکیده

برخی از مدل‌های پیش‌بینی بر پایه‌ی صورت‌های گوناگونی از منحنی رشد لجیستیکی قرار دارند. این مقاله با به‌کارگیری مدل لجیستیکی، مدل لجیستیکی هاروی و مدل هاروی به پیش‌بینی مصرف برق در ایران می‌پردازد. مدل‌های رشد "لجیستیک"، "لجیستیک هاروی" و "هاروی"، برای پیش‌بینی مصرف برق در ایران برای بخش‌های خانگی، غیر خانگی و کل برق به کار رفته و کارآمدی این مدل‌ها برای پیش‌بینی ارزیابی شده است. مقایسه نشان می‌دهد که مدل هاروی بهتر از مدل‌های دیگر مصرف برق ایران را پیش‌بینی می‌کند.

طبقه‌بندی JEL: Q40, O53, Q49

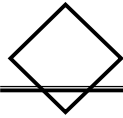
کلید واژه: لجستیک، لجستیک هاروی، هاروی، پیش‌بینی مصرف برق ایران

# \$ % '&



(#

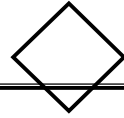
%& !"# \$  
,+ )&. ' ( ' & ) \* +  
3 6 !6 - 7 4% / 5 0 & 3 + 1 \* 2  
8 " !< ' \* & \$ ' 8 9 : / ;  
3 6 - + 0 & \* . 9 = > 5 ? - %& ; 1  
3:'B9 = ' ' 8A ; 8 @  
, - C% \$ D  
0 & \* + 1 \* EB F\$ 7 : G \$ / \*  
/+ \*J,\*6 0 : H I \* D \*  
, - - \*\* + 6 \* ) + F% 55 :  
K 85 ! K 51% D  
, 4 : / L # \* O \$ @ , - 9& % @ N # 7  
M M # \* / S96 ' + - 1 \* & P Q R ? 1  
- & I ? \* ' QV \* R% T : '  
9 L # % & N + G  
3 ' + ? 1 Q R 3 ' QLK 5 ' K : & / D  
X - 8 9 ' , W , ! K 5 3Q : , '  
+ \$ F 1 L - + 7 K 5 Y : @% \$ 1  
K 5 , \$ Y Z & K : + / : ' D \$ F 1  
; %  
P Z # ) - K I S K I P : ) - Z # 5 \* Y :  
- 9 & 15 W ' - + 3 % L 6 B K 1  
> L 4 8 + GG 4 K I - . 7 &  
7 : K + 5 1 Z 3 K I %  
% D F 5 + Z K % -



2 7 3 " 4 506.1" ( , , - . \* ./ (\* + )

9 . )6.:;8.1  
' ' 9 Q + ' M[ \$ , ' 2KM5I ) M <  
^ % QW: T , - 9 6: 5 D \* K'D5  
+ / : " : ` L A + L' : # : + 9 V : B + D V \*  
+ & ! ' \$ F1 \$ F'1 + L ' 0 \* +  
; D 9 WT!# 7 K 5 L '\$'  
^ % Lh  
'9 + M' 7 \* ]@Uc F  
9 %W - 4 9 V- D : B + ]]ccba&  
6 e , ?@ & ? \* M' 7 - D  
%  
gh ' V S\* ?]Uc M\ f "!'M  
7 +9 VD 8: B#\* - 1D! X +S 7  
: ;; B %Y- & ? \* \* 7 X , S  
, - X S 7 . V & : B 9 - D L  
%  
\* - D & : S1 7 ^ KU5\_ "!' -  
+ + - D V \* L - - 9 V9 W  
9 V \* L \$ ? % Z 9  
%K+5 6 9 Q : 'S1 k  
& : M & : 5 7 ? 4 UT i !#  
99 V 9 : % - - D L ]@Uc @- '  
M4 H1 4 1 '\* V Y& ? Z\*# 7  
; D Y 1 % , ? ! ? ! ? BV 7 , !  
9 , - j 3 \$ Z\* 84 \ + G 47KI

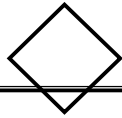
# \$ % &



G ? 1,3%: B \$ K Z59 j M M! 1  
 ; K 5 L': 6 B \$ Z^ \_L l- +  
 9 V :B S\$ F\* L B + K 5 3M &K &  
 9 UW<sup>1</sup> - \$ F1 T S F L ' + '\$ F1 ++ 4  
 G > ' ? L\$ : ' Z Z Z# +%1 Z  
 Q ! F 9 %8! < 4n( G P M^ ' 4 m  
 , S \$ . , 7 & KM5& ' L  
 , - % L' G  
 'K: 5 5 0 j d b+9 W' !' "-  
 7 S\* 3 \$ - \*X L' Z3 \$ /  
 + 7 R Z\* QGS \$ Sp' - " :1 ;%D  
 7 - 9 \$ M! H1 \* : ' V  
 " \$ F S @ \* 9 GW\$ !' 5 ' & -  
 +) - 0 \* " \$ F1 0 V \* & 8 m, ; j  
 , ; D % \$ Z

9.):: < '\$ =  
 9 8 :M/\$\* - ; 5 @ W' \$ F1  
 9= :K :&5 D D '9 KW -  
 " \$ F1 :#: 0 \* X \$ F1 \$ F1 +L% 1 :"\*  
 & - G1 , - M" :#: " \$ F01 9 :#: %  
 `q- G \$ M' , \$ I , ? ! U < : ! F  
 G \$ ' \* +9: + , ? < M @ M @  
 : - @ S\* Z F r : F @ ?  
 + - : , \$ & + < " : S S < : " D \$ F D

! " # \$  
 %  
 & \$



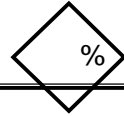
2 → 3 " 4 506.1" (, , -. \*./ (\*+ )

e. !- @ ρ - :+ + ! G ?! +  
 , - 9% ; D  
 4 ) F 9 D & 9 W9- - LZ\$ # 1& ?\*  
 4 5: %D D )&4 K')5E @ (m  
 ":K \$5F 1 ] d H S&; 1 L r  
 " \$] E \_8 M#\* & 9 W - : 9 e N S\*  
 % 9 9 W - \* q-?\*K 5  
 a S\* ; ] G 1 - +  
 t ; +, -m 9 " >\$ F 1M :L & ? :  
 8 ; \* "M \$ k - 4\* : !N : ;\*  
 S?\* + ; .\* 8 \$ W Y e& 9 ,W -% S\*P Z#\*  
 8 @ M M\$\*De " m\$ F 1 & ; \*  
 % # e. 7 - ? 1  
 U+ \$ F 1 0 \* L & ; D " TL\$ F 1  
 9 9 MS' - , \$ , S\$  
 9 , # ' L : u +K 5 6 ' , %  
 / - p L ' 8 S9 N'  
 +T \* 9 W - \$ B C S&; F ?\*\*  
 Z , \$ I I \* + ' 95& & I % M + '  
 K : 5& \$ F 1 0 ' \* & 8 m @ % S p -  
 0 \* ' : # ; + # ' , M < , - M \* 1  
 Z K + @ : @ ' ^ % U # \$ F 1  
 E \$ # " \$ F 1 & L ' D = Q T S + !  
 - p - Q . S + p 1 - & Z 9 + &

( ! )

\* + \$ \$

# \$ % &

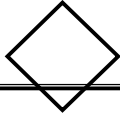


0 ; - & ' K d e a ' + X %  
 & L' ,% 69 5 6: 5 F1 0 " # \$ ,  
 > L + , \$ L Q S 5 - ! ! \* ? & 8 S  
 - % - / & N /  
 L% ' L ' \$ v F1 L Q ] d u a L'  
 8 ? \* L 5 ,% +9 L: 1 ! ? X \$ - F1 LL  
 " \$ F1 S ! \* & - - \$ F1 ! L ;  
 %

MK: 5& @: 10 & , ) & e ? 1  
 , - K 5 ' 6 " 8 \$ L F1 L ' +7  
 ^ U a ! # 9 ? 1 + x ( \* S : W  
 7 \$ ' F1 L , K 5  
 ' L ' 4 5 1 : 10 &  
 % L P K 5 \$ Z

( ? @ ;  
 , - . \* . / ( , - . \* . / # (   
 b M ^ \* : \$ ' ? R K \* 9 V \* L ' & -  
 e ' + ? R & - ] d e ' '   
 ' L +9K \* & > D e ' , S \$  
 ; ? S \* ? 9 ? \* & \$ M \* , - + M Z  
 , - 9 10 y // ; L ( 4  
 , & w m " \$ \* F1 0 \* , 7 \*  
 , [ / U

0 + !  
 # \$ /  
 \* \$ /



! " #

& \$ %

( ) \* + , % -

. / & % 0 1

< = > !@#%29 5 \$ 1 0 : ; 1 7 4 % 2

4 @ ? B @ 9 8 12 3 9

— C — C

7 D 0 ( E F E 6 - C 3 +

C 4 4 C I 4 @ B H

J % 8 % K

7 L : = % O M N ) ( " >

( ) \* + E 3 \$ Q 3 E % B, P L

% Q . + % % = B R M 3

— C<sub>4</sub> — H

& S . / % — C<sub>4</sub> ( ) \* + 1 0 \$ Q

T R 7 N 3 3 0 + ( H 3

= , O 7 8 % D N & % W ( 1 0 % % Q D

D' + \$ % 2 W Q R V W + D

C<sub>4</sub>

C<sub>4</sub> 3 % " % 2 X ) + S (

, O & Z ] \ \*

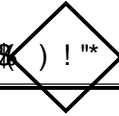
C<sub>4</sub> T

5674

2340 +

& %

# % ) ! " \*



7

B

,

O

4

P

0

% X

4

C

A

1 D M

08 % K %

%

2

(

!

%

2

%

U

B \$ ' 3

4

C

4

^

\_ =

+

Q

7

E

)

=

^

3

E

'

S

+

J

%

-

8

%

K

E

& = [

~~BB~~

b c 7 B G 3

D

N

d

Q

=

)

a

+

4

G

a

+

a

=

+

)

(

%

a

M

\*

%

=

P

(

!

%

2

%

U

% 2

a

E

Q

4

P

O

D

=

B

3

=

c

4

@

G

H

b

=

+

=

)

4

%

a

+

1 D M

O

0

3

1

0

%

Q

5

%

3

B

\$

@

'

3

=

>

@

4

4

4

4

E

,

(

)

\*

&

+

,

%

-

R

M

B

Y

6

0

+

\

-

@

E

3

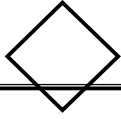
%

4

4

4'Y





4 , O a 0% ( > D = 1 %  
 0? @&@-1, 0 DDM \$  
 D c , D 1 P%% , E 3 , O a % ( >  
 O % U 1 0 + " ( , O 20 \$3X  
 EQ,% 0 < , 1 < , b P  
 1 # ; < 8 = <  
 , f % D , 1 % 3 (=D 1  
 % E7 &% R 3 KK\*+ % 2 % Q % 4 I T !  
 = = (Q D Q D(g=2!1 ,  
 : = ( > = Q+ END, ,(= 7& / (=   
 FE+ , 0 \$D, :( 1= Q P 9 E L0 1  
 (=R% Nn &D > MX NS!( 1  
 0 % D = - 0 E" , b = , % i  
 D )(V=bE ]11 & V ])0" %1K \$ Q  
 Q 7 0 1 Q 3 N 1 % b % )i+ %  
 Q E , % i (= ( D\$ m\*6 .  
 7 ]11 1 % , D )1V D b MX D] >(E , 3+n  
 48 ^% 20 1\$ , % i > = = >  
 60- 1\$ 1 ! =Q = , %%i % 5 PS+ (=   
 c= 0 7 \$ D= D &M ! 0 %1-\$ ! e=< )3+ % !  
 0 % h= 0E6 % M%N, g;% )3+Q% !! = <  
 > O J% 8% % E, % i 13 , % i  
 ( = % 2 Q b , " > O% h  
 7 & , \* " jk Q 0 , %2i bc6

---

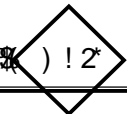
" !  
 # \$ % & %%

5674

23/0 +

& %

# % ) ! 2\*



1

D

? @ B %

	q	1	0 E c d			D	% i
	q	p	E3			0 1 \$	
	q	q	40Y	0	4		
	q	q	C	T	CC	H	>
	q	q	C	T	CC	H	> O
	q	q	C	T	CC	H	b Q

E & = 1 V g % V" 0 6] D E% + 7 % V  
5n 0 S + \_ =

1 D

? @ B %

	q	1	0 E c d %			D	% i
	e	p	E3			0 1 \$	
	e	q	40Y	0	4		
	e	q	A Y	@ H	A 4 T	4 4	>
	e	q	A Y @	@ H 4	A 4 T e	G G	> C
	e	q	A Y	@ H	A 4 T	I	b Q

E & = 1 V g % V D E, ] 0 6 . + % 7 % V  
n 0 S +

8 E

\ - E % , ,

, % Q 2

0 % = D J % , 8 % K J % D D % K

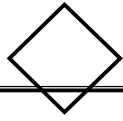
\$ % % t % \* , R 1 D 4 1 D G T M

\$ % , % 7 D & ) D M ] % 1 , % ! -

b Q & % K D ! % 2 % U O % h Q > > O 8 % K J %

% u % λ \* 0 20 % h 8 % K ) O \ \*

D E B Q E 1 < J P + ( 8 % K



!6

**B %**

0 EV Q %2D I 0/9, Q

C<sub>4</sub> ? % 3 % 2 % X \ " % E

RI 3 J% 8% 10 % b hQ > \$ % \ \* & = %

47 D & D \$ 410

> OB 8 % K C ^ 4#4' C 4'4

T @ 410

> O % B h 8 % K C ( 4T44'4 4'C

H A 44^

b Q B % K Q 470TAT 4 I

(TT@ 4HA

**B %**

] b Q Q \ \* Q % # 1 % ), E

7 % = 1 % BX D%\_ 8

> OB 8 % K 4 C ( IG 4T H' 4'H

(IG G 4@

4 C ( ^ 4TCT' 4'T

( IYA 4T

b Q B % K 4 C ( G 4MHT 4'A

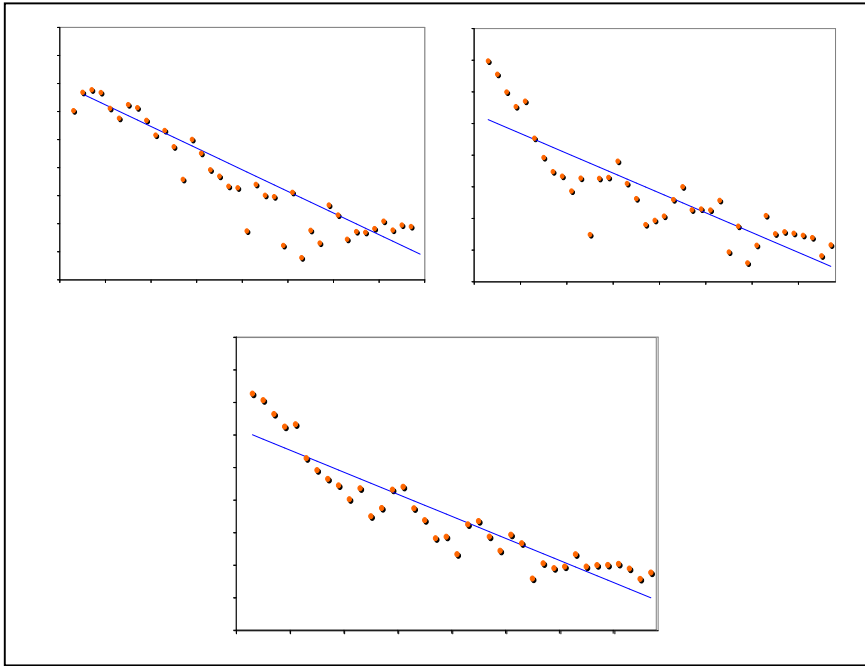
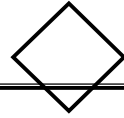
(HYG 4(HC

% 7 0 8 % \$ K O 2% )W )

C<sub>4</sub>

7 D 8 0 6 b Q b 4 O % h

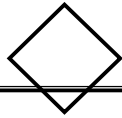
# \$ % &



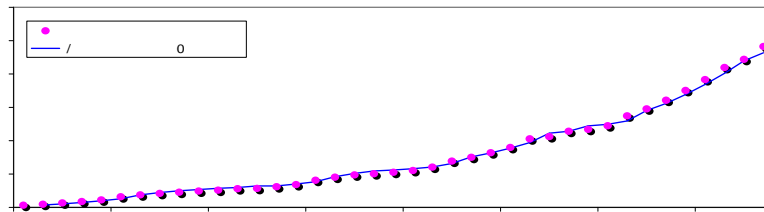
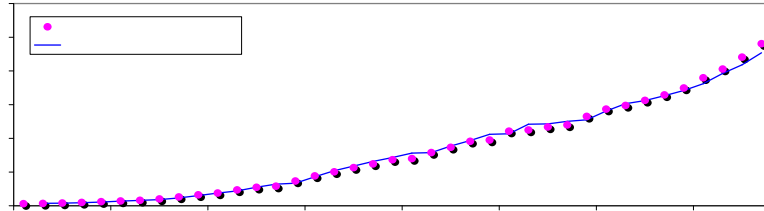
) 0 1 2 0 405 \$ + 6 1 7 ) \* + # ' - .

\$ % & #

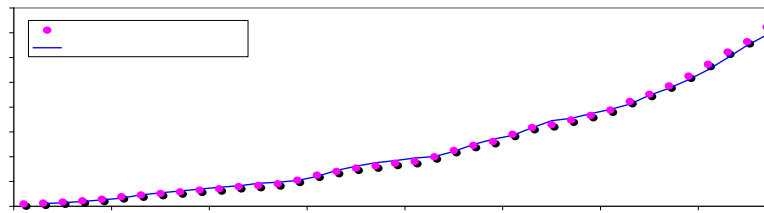
/ ( " \$ # % / & / 1 / (\$ ) 2 \* + , - .  
 % / 8 / - / # / 5 / t 7 6 1 5 4 3  
 ( : / ( / " ; ( ( : / 4 : // : 1 ) = % & 0  
 @ & ' 7 1 6 3 - #  
 ( 6 ( / B " / # C \$ D ( 6 E 6 ( \* F : 6 G A 8 ' 6  
 / " ; ( ( 1 " # : D % 8 9 & 1  
 / - / 0 ( / I \* / 9 % 1 ( 5 - \$ : (( D I  
 8 J + : 7 . ) % K : \* + L 2 - ( 8 % 9 D 1



< 8@ = " > )?+: "+; 1 0 3+ 4+5 4 8 9



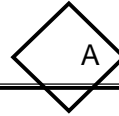
! " # \$ % &



0 3+ 45 1 6 " 1 07 " 02) 0\* '1

				0	1	( <del>8</del> 8
M	(	N	)"		6	( D
			(	(	( P%	60 % "
	P	5	SS45	4	Q55@	R A
		@	@	Q	@	
	3 P	S45		4	5@ 4	A
		R4		S4	Q	
7 1	P	5 5 4 Q		Q45	54	
		R		@	5Q@	

# \$ % &

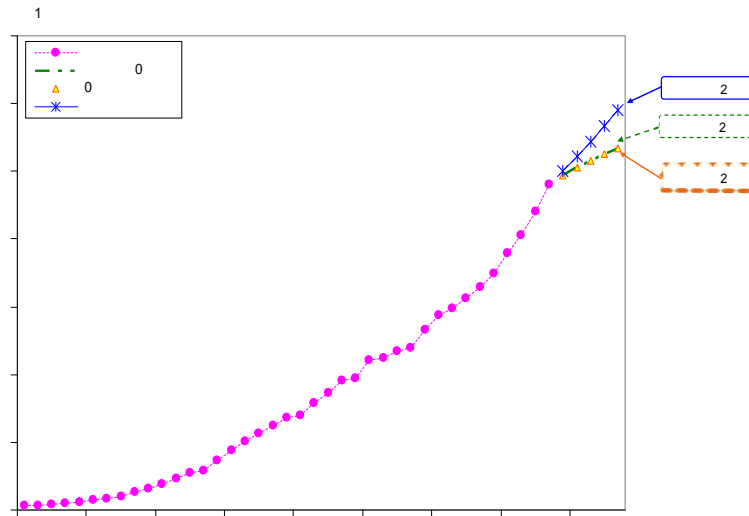


D / U : / I / D ( ! 6 ( V ' % (
/ / \* F 6 % / Z # / : T X @ ( D 0 9 W %
g † 1 & [ ( 7 1 6 M N B (

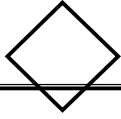
0 0 3 + 4 + 5 # 8 ( 9

> 0 ? 8 7 C < D +

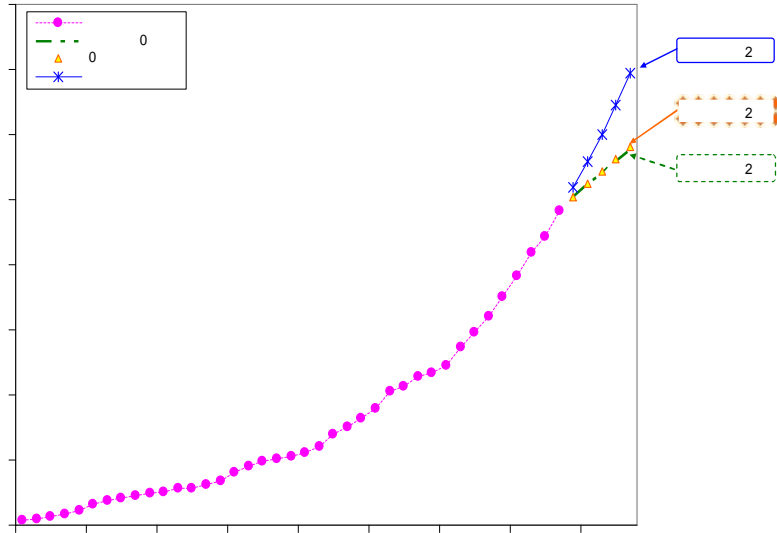
/ / 6 ( / 6 B " / # D C \$ D M \
7 > 8 ( 6 S A C G ( : Y A 7 8 ( N 7 1 6 3
/ / M / \ / % Z 8 & B 9 ' <
0 9 1 % [ ; % G ( : Y ( N D
& ' N M \ ( 0 ( D Z M 6 ( D
/ B / % [ % " # Z C \$ 6 6 B " # B C \$ D M \ 1 % 0
& ' !



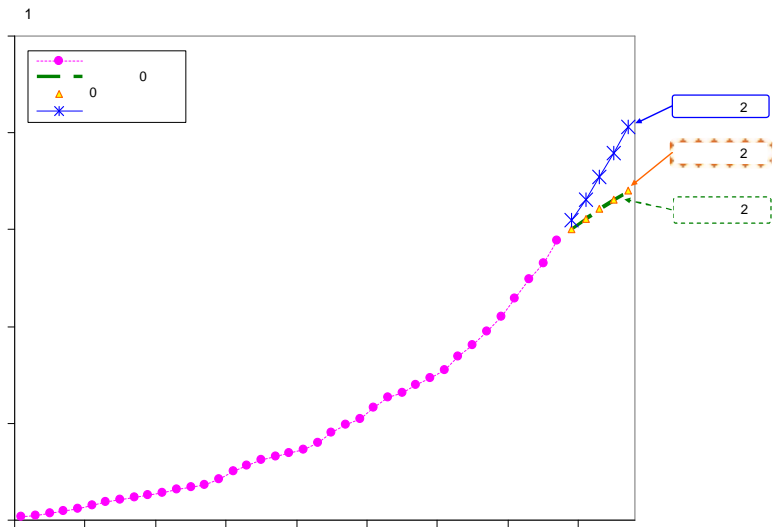
0 0 3 + 4 5 F 3 1 + 4 6 5 " = " ) E + " : . + > \$ \*
# \$ % & H



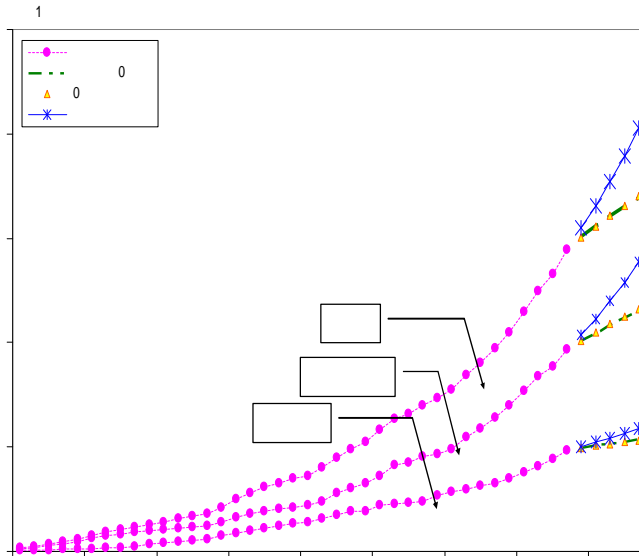
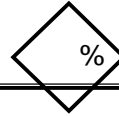
< 8 = " > )?+: "+; 1 @ 3+ 4+5 4 8 9



" += " ) E : + ; ) ? ( \* ' # \$ % & 'H



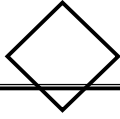
" += > ) E ) ? + : "+; @ \* # \$ % & 'AHO



# \$ % & AH 6 = " J 0 EE ..>+I F)?:+"; A \*

D 6 // < ( 9 8 // 8 D 6 // 16 % // Z  
 !/ / / , 6 ( 6 B "# C\$ D 6  
 9 6 ( D 0 (" # 0 9 % [ 0 9  
 ^ ( ( : I %% Z D 6 ( D & %  
 0 9  
 6 3 Q & : # 1 6 4 ( 6  
 / D / 1 % / (& // ( D 6 / ( " ; ( 6 ( 1 D ( 7  
 % / ( \$ % / % 9 ) # \$ - 6 - . ' \$ # %  
 6 B "/# C\$ bMD \# 9 ` 0 a 6 ( M DD  
 # K ( - 8 D - 0 8 J < / 6 ( 6 (& : B "# C\$  
 , / 6 / D / - / / c " 6 ( \ d 0 - B "% C\$  
 7 / - F & e / 6 % Z D / ( : 8 e % Z' # < W :- ; :  
 G ( / F 6 ( / D / / 1 : / 8 : K e ( - 9 , % 6 % [ C





!

#( % &

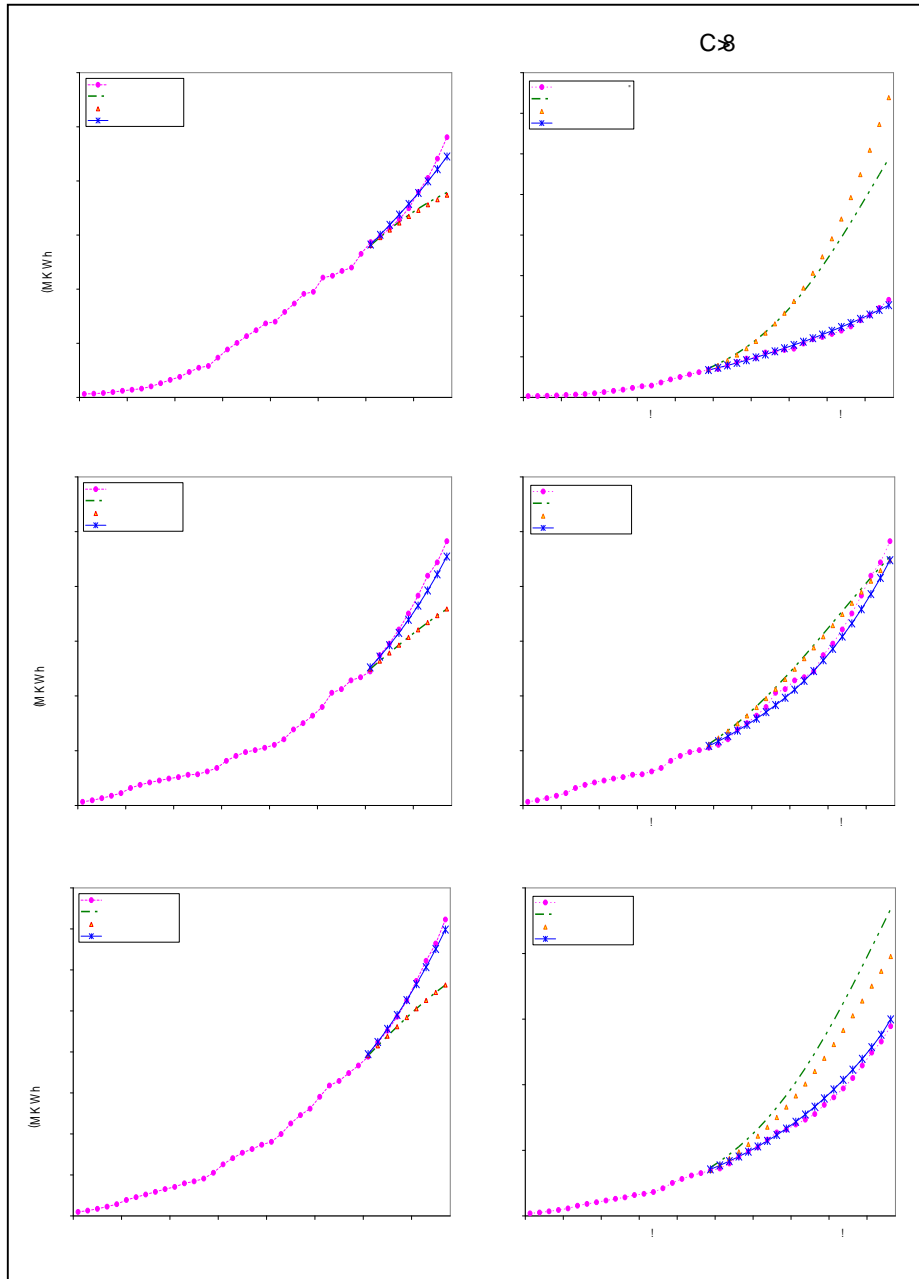
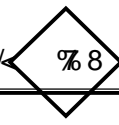
/ 0 - %&(' , ( ) \* \$ # !

* 4 2 0			* - . / 0 ,		
8 9 5	5 6	5 6	8 9 5	5 6	1 . 5
	1	1		1 7	
(	&(&	#&	)#	:&	( )
(	&#	#)	:#	%'	&(<
#	#(	%&	'	)#	( (

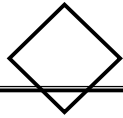
8 > AB > , @ " 0 > DE ? F > @ > > 4 > !  
 " G G , @ I 3 1 , # GG' H3  
 > # \$ , 4 M K # % DJ 9  
 >> G 4 , 8 D0 4 H I  
 + 1 N 3

35 6 2

O > @ > 9 > >> > "  
 C , D O R > F FG 2 3 Q , " DJ , 9  
 > T > @ 4 > > I P 3 0 , F 0 , 9 , S 9  
 2 9 W 4 X 0 , G U ? > C U W "  
 > > > V G 4 Y W K G B 2 0 M D E  
 3 > 4 > . >> 0 > , > M Z H K W 2 I P 3 , I F  
 C >> DW ? 4 4 - . " M M " 9  
 > S > 9 9 T 4 @ 4 0 , 0 ? , , 9 @ 3 , \ 9  
 # > & : 2 > > > V 4 2 , 3 , I F N 3  
 >> G '\$ > " G ` G M # < & & &  
 # & \* M # 2 1 & % ) L , R # < 3 3



) \* & .F "74 ; \$ > C 8 4B



7F

4DJ 89 1 .5 6 " 1 . Q,  
 >9 >R9 >L2 M>MG " 4M, M 9  
 > 3 > >-> " > >PH 2 bF>G 4> > ^  
 >D " >>W> >94'M  
 > 4> W L 0,"9K9 , "OV  
 U"±> O P , G ? H 9  
 MDJ 0, G P 4  
 >P K >P>0,> L L > -. / 0,1  
 4M 12 M 2 F 0 DE G+ P  
 /> 0 1 > 8276M, >G K > ^F N  
 > c > 8>9 5 76" 1E 1 G -.  
 L C 0, R 0' DE , +? J  
 F > N > "0, G 2 d"6 . 4.  
 > " Y! 0, eI?G 4 2 4  
 >E > > > > > R# +B  
 >G >M " + 0, O -c 5 6 .879 " 11 .  
 #G%: f I F 9, ? ? 5 6 . c  
 7 5>6 G M "G W #G\$(#(f  
 T4 @4 0, #<G(18\$ #G%"FS f  
 >M > +G "1 A9 4J c 54 6 2 M C? 1  
 " 1 >>. 5 >6 >> >>f Y> >> @%e>G 4  
 # G 2 9 89 71 .

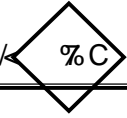
---

+G 2 M 2 3 I 10, G4 L - , I 4V Q# "

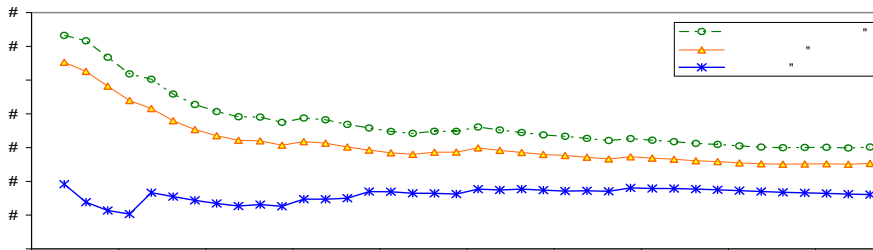
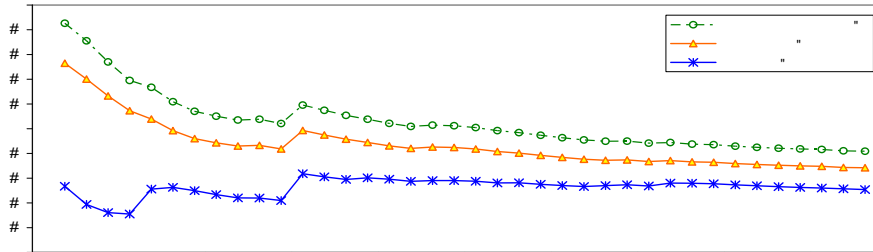
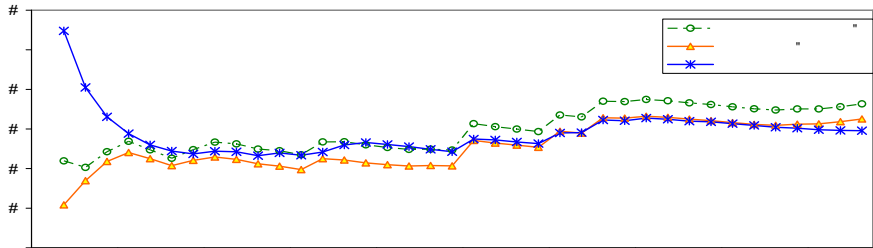
F " 7E

7C 4B : \*

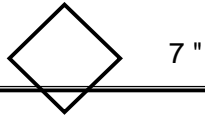
4 9,\*/ %C



I		H		D !	
G	8 9 5	G	5 6	G	1 . 5
8 9 5		1 . 7	1 .	1 . 5	
(&	#) = (&	=&&	# ( &	'=	) ( #);# # <
&'	# : )=;	&'	# # #%	'#	) ' ' &= # <
(&#	# & &#;	)&=	# # \$	# %	) = #; &# # <
&(	# % \$	&:	# ' \$ (;	#=	) = #; \$ # <
&(	' ( ' \$ ;	)&&	# < %	#(	) % \$ \$ # <
(&#		)&=		# %	G M



+ B JK % & ' ( ) \* \$ 97GB

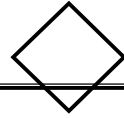


L#\*  
> , I G 4 " I 0,  
> G G ^2 M G , 20 R+X " P  
> 9" M 24 M U ~~4~~ D B 6  
> 0, ~~X~~ H 5 6 a I  
8>9 1 >. 7 G 1 >. E , F 5 \ ., G  
> U 0 , > > > - . /> 0 ! 4 c U 5 6"  
B>f P F M Z H c , I ' C  
> > 8 4 \* X 8 a M 4 .  
D F Z H G O G " 4 U O P 1 ,  
M + 4 .

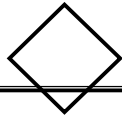
' 3 > E /  
g + C , L ?" g, g 4 # < 1 % : F  
" D W " D S , D 1 6 A P ! # 4 \* & & H "  
N 2 1 + K

! " # \$ % & ' "  
\$ ( ) \* + \* , + + -  
" . \$ & ) ( ) ' / / " 0 ) ) " ) 1 ( " )  
2 2 " ) ) \$ ) \$ 3 \$ ) % % 4 \$ 5 6 -- , +  
( \$ . 3 - 1 ( ) ) ( \$ \$ ) ) \$ "  
! " ) ) . ( 7 # \$ % 2 ) \$ 8 9 \$ ( " \$ # \$ % 2 ) \$  
& 3 \$ " ( ) " ) \$ ( : ) " # \$ ( - , 6 /  
( " ) ( " % % \$ < \$ + = \$ % ) > ) ' "  
\$ " ) ) . # ) \$ \$ % 2 \$ # \$ 2 ( . + ; \* \* ? ; +  
) < \$ ) \$ # ) ) ) 1 ( ) ) 4 \$ \$ < ) \$  
& ) ! ! ) \$ " ( . ) \$ " ) ) . # ) \$ \$ % \$ \$  
8 \$ ) 3 ) \$ " " ( ) \$ ( : # \$ ( " + ; \* , + 6  
< . # / 6 3 ) % ) \$ ( \$ 1 ( ) ) # <  
5 A 2 6 \* , 6 .

# \$ !%



! " # \$  
% ( " # \$ &' ( ) !\* (+ , -)  
.  
( ! ( 1 ! ( / 0 ! ( ( 1 ( ! 2  
( ! 3' 3 % 3  
4 ! 5 '\$ ( ) 0 + ! ( ! ( 84/  
1 ( 0 6 ( ( 7 ) ' '# ''  
( 4 0 0 8 / 4 ( ( ! ( 6 1 7 ) \*  
( ! 3 \$9 % 3 ( ( 1 ( ! 2  
) 4 0 0 8 / 4 1 ( ! 6 ( 7 () \* /  
6 ! ! 0 ( 5 7 7 : 9%  
) & ; 9 # '' - (< : .  
= 7 ) @ >, ? ! 6" \$ % 9 ! 0 6 ( ( 6 !  
1 ( ! 5 6 ; 8 '' : ! +  
6 ! 9 % " ( ! 0 6 ! 7 ) \* 0 6 ( ( +  
< ) ( 1 ( ! 0 ; / 7 17 \* ( ; ; < 6 ( ( )  
( ! ( ( 1 ! 2 ( "" ! # ""



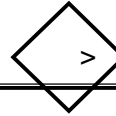
0 5 1 " 2 3 4.,/ ) \* \* +, &,- )&' (

6 7, /

3: ; 1 ""+2 &,\*- \* +, &- 9 \* 3 4,7.,/ 687, /  
= 0 < '

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

# \$ !%

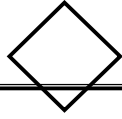


( )&)	( (!" "	( )("	( !	!
( %'&	(&)'('	( #'("	( ##	!&
(&(!##	( &&!)	(& '&)	(" & (	!"
(!%'&	(% '#	(% #	(% "%	!!
)#'(	)(!)	)%&	(#!&	!%
) ("	(' &	&)#	(" "	!#
( # '(	(" #%	& &	(% #	% )
)"%"	(&()	%(&)	# "	%
" )#	" (!"	" #%	!#"!	% (
# %	# (&)	) ")	)& "	%
!!'&	%' "#	(%&	)%	%
& (%&	& %)	" "	% )%	% (

3: ; , ? 1 " 2" + , & , - \* % - @ , \* 7: .34 , " 6 (7 , /  
= 0 <

*				
\$\$\$&	\$\$\$&	\$\$\$&	(	!
%&	)	((#!	%#	%
( ) )'	( )&&&	( !" (	(" "	#
(%&& %	(##' #	& &	& "	& )
% ( (	# !!	( !%&	& ) &	&
# '(	& )'#	& %%	" !	& (
! & )#	! #/&%	!)&&	!& (	&
% & )#	% #)!	% '%	% (	&
# '#&	# #(#&	# ')	#	& &
) ( !%	) ")%&	# %&	# % (	& "
%)%&	& '&	)"!(&	) %	& !
& ) (	# ( )	( ('&	(	& %

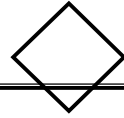




0 @ 1 " 2 3 4.,"/ ) \* \* + , & , - ) & ' (

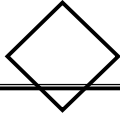
*				
( ("!	( %# (	( & %/	%	& #
( # {	( %'#"	( !")	( ( & "	)
")(&	# %&	& ! (	!)	"
# %/d	& ) &	#& !	" (#	" (
! # & &	% " ! #	! & ' #	% )	"
# %& !	( ) " ! %	# ) !	# #	"
( ( &	( %) " !	( ) %' # &	( ) ( )	" &
( # ( #	( (%' &	( ! &	( ) ! (	" "
(( ! " " "	( % (	(( ! % &	(( &	" !
( % & !	( ( "	( ) & (	( " &	" %
( & & (( %	( " # !	( " # / #)	( ! ! "	" #
( # % ( &	( ) ! ( %	( # % ! #	( ) !	! )
(( & %	( " ) "	(( #	( ! # !	!
& ) # )	& & (( %	& ! %	& # !	! (
% # # "	% % ! ! )	% & )	& (	!
) ) %	# / #	% & %	( %	!
& # # &	& ! & "	& !	& " !	! &
% & %	% % % ) %	% % %	" %	! "
# % &	# % # !	& ) %	% # '	!!
& & ) "	& % )	& ( # ) #	& # )	! %
& ! % & (	& % % %	& # # & &	& # )	! #
" ( ) ' &	" ( & &	" & # )	" ( %	% )
" ! ! & %	" ! " ! "	" # % ) &	! ) )	%
! & )	! " # )	! & % / #)	! " " &	% (
% ) ' & )	% ) ! "	% ( ' %	% # )	%
% ! ) " % )	% ! % ! !	% # %	% % !	%
# ( & ( \	# ( ! "	# & ( ) ! #	# " &	% &

# \$ !%



1 " A 2" +, &, - \* &- 9, \* 7: .34, " 8(7, /  
= 0 < '

+,				
\$ \$ \$ :	\$ \$ \$ \$	\$ \$ \$ \$	# "	!
( ) % %	( ' !	( % ! ( &	( & %	%
( ! # &	( % ' &	& ' &	! (	#
! " %	% & #	! # #	& #	& )
# &	& " (	& & ! ( %	& ! (	&
" ' ! &	" & # "	" % % :	!! # "	& (
% ! # )	# ( ' !	% & "	# &	&
) %	) % ' & &	) # &	) "	&
% ' &	( %	! & ' &	!	& &
( % "	% ( " #	# )	) "	& "
! &	& # !	& %	&	& !
& % % :	" & ' "	& ! ( &	& #	& %
! % ) "	% & " (	! " ) (	" % "	& #
% ! ( #	# ( ! %	% " ) %	% ( "	)
( ) ( ' )	( ) % ' & (	( ) % #	( ) &	"
( & %	( ) ' )	( ! ( %	( & &	" (
( % ) ' &	( % & &	( ! & "	( % !	"
% (	( ! ) (	) & "	) %	"
( ( !	& % & #	) "	( " #	" &
& % % :	" % %	& ( %	! )	" "
% ( ' &	% % &	! & ) &	" !	" !
# ) " &	) ! #	# ( ' &	# # &	" %
(' (	( ) ' &	( % (	& )	" #
# % )	# % % %	% & %	# !	! )
& ( ' &	& ) %	& ( % %	& ( )	!
& " # (	& ! & %	& " & !	& %	! (
" ( & !	" ' #	" ( % #	" " (	!
" % ! ( &	" # % #	" % ( "	" & %	!



\$'	\$"#	\$#	!"!	
'\$%	'!#	'&#%	&	!
!\$&	&!\$%	&'#&	!''	
&%&	&%#&	&'#&	&'!	&
&"\$	&"\$&	"\$#%	"\$!	"
"' #"	" %#!	" #	"	&\$
\$ #!	\$ %#!	\$ '#\$	\$ \$	&
\$ " #!	\$ #%	%!&	'!%	& %
"' &	" &# %	% %#!	% '!'!	&
% " &	% " &#!	&#	% &	&'
%	& %	'% #!	'' "	&