

5HSRUW 1R 3 1&3 5 5HY 1 &  
5HSRUW 'DWH 0DUFK

6ROYD\ )RUPHUO\ \$GYDQFHG &RF  
070 &) 5: . 3: \$6 )DEUL  
/+ FXUH F\FOH FRPSDUHG WR 0  
(TXLYDOHQF\ 6WDWLVLVLFDO \$0

)\$\$ 6SHFLDO 3URMHFW 1XPEHU 63 : , 4

1&\$03 'RFXPHQW 1&3 53 5HY 1 &

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3UHSDUHG E\

(OL]DEHWK &ODUNVRQ

5HYLHZHG E\

-RQDWKDQ 7LVDFN

.DWKHUL

\$SSURYHG E\

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/LVW RI 7DEOHV

7DEOH 7HWW \$EIRVSHRQD  
7DEOH (QYLURQBHWWRDQV &\$EEUHYLDWLRQV  
7DEOH 2QH VLGHWWRBQHEBDCFLPLDQVYDQXHDVSOH PHDQ  
7DEOH 2QH VLGHWWRBQHEBDCFLPLDQVYDQXHDVSOH PLQL  
7DEOH )DHLXGHWV 6FDOH  
7DEOH 6XPPDUORRQFTXLYWDV 5HVXOWV  
7DEOH :DUSV&BRQUGHWBHWQDWWK  
7DEOH :DUSV&BRQUGHWBHWQDWWK  
7DEOH :DUSV&BRQUGHWBHWQDWWK

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,QWURGXFWRQ

7KLV UHSRUW FRQVHULOH WKH WRTXNDXOIRVRRUO\ \$GYDQFHG  
&RPSRVLWHV \*URXS 070 5: &). 3: \$6 )DEULFXU/H 'F\FOH  
FRPSDUHG WRTXNDXOIRVRRUO WLRQ SDQHOO+ SERGXFFHGOXVLRQ  
VDPH PDWHULDO 7KHQDWPLRQDWXOIRVRRUO WRTXNDXOIRVRRUO  
ZLWK )\$\$ RYHUVLJKVSHFKLDRX3KR)S\$F6W 1X4PBRG 030VR: ,PHHW  
WKH UHTXLUHPHQW 03R6WDRQDRGLQSH8\$DW6.3J 3URKHHG&UH

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RQ WKH UDZ PDWHUWLBOLVDDQEDQXZDFDQGLSJRHFHXVLSRPMQW D

(QYLURQPHQWDO &RSGLDWLRQH 7\$E	EUHYLDWLRQ
&ROG 7HP SHUDWXUHÍ 'U\ )	&7'
5RRP 7HP SHUDWXUH 'U\ )	ž )
(OHYDWHG 7HP SHUDWXU )	(7'
(OHYDWHG 7HP SHUDWXU )	(7:
(OHYDWHG 7HP SHUDWXUH :HW ž )	(7:

7DEOH (QYLURQPHQWDO &RSGLDWLRQH 7\$E EUHYLDWLRQV

7HVWV ZLWK D HQXIPDEMHUOLPEWHV LDKMHL RDK HQGDV D S/H

<sup>3</sup>4XDVL ,VRWURSLF´

<sup>3</sup>6RIW´

<sup>3</sup>+DUG´

(; 2+7 LV DQ RSHQ WRWV WLMQW LTRDVL LVRWURSLF







:LWK D R E D E L S U L W \ R H R Q T X L R Y D O R D I E G X W H V W G X H W R U D O  
FKDQFH DORQH DVINZKR D O C H I S G W H Q / G R H T X H L Y P D Q H W W L O O E H  
SUHVXPHG SURY L D H G X W K D V D U W K E R W V H Y H U H

6WUHQJWK DQG ORGXOXV 7HVWV

)RU VWUHQJWK WHHV S U Y B D X H O \ Z R I Q T H H Q X I G Y B Q O Q E H W O P S O I  
VKRZV ORZHU VWUHQJWK R Y D L Q X Q Y D O W F H O D O I L F B W L R Q B D W H U U  
DV D μ R Q H V L G H G † K \ S R W K H V L V W H V W H G L D J K H U R E Y O I O X H W K R U X  
W K H \ P D \ L Q G L F D V E H H V Z G H I Q H W K E F M Z R T P X L W B O I H O F V I V X P I S O H  
P H D Q D Q G V D P S O H P D O I P K R P Y S D O X H G V D J D L Q H V I S H M F W H H O L Y Q L O P X H  
I R U W K R V H V W D W I E R W S K W H Z K L E R P D W H W H T X D O H M L X F O W W L R Q

7KH H[SHFWHG YDOXH V D Q H W R P S X D V Z H G H O H O Q T O V E I O G L Q  
DFFRUGLQJ WR WKH IROORZLQJ IRUPXODV

7KH PHDQ  $PXV \bar{X}$  <sup>finite</sup> H [ F H Z K H  $\bar{X}$  H D Q G 6 D U H U H V S H F W L Y H O V  
P H D Q D Q G W K H V W D Q G V K L H G T Q I D Y O L L D M F L D R V L R Q V D P S O H

7KH V D P S O H P L Q L P X  $\bar{X}$  <sup>finite</sup> P  $\bar{X}$  V W S H Z I K H H I G D Q G 6 D U H  
U H V S H F W L Y H O \ W K W D E G Q U D Q G H W K B M F L D R V L R Q W I O H P S O I D O

, I H L W K H U W K H P H D Q D R O J W K E H O R Q L W P K F X R [ S M I K M W G P P S Q H L L V  
F R Q V L G H U H G W R K D Q F \ I D R L O H V K D W X E G Y D O H K M H O X L O O V K F S B W K H  
U H M H F W H G 7 K H S U R I E D W E K E U W W K R H P H O Q P R W H W W H W K Q . O H Y H  
V H W D W

)RU ORGXOXV YDOXH V I M K O X U T X I R Y F O H O F H V V I P S O H U P W R R K  
W R R O R Z F R P S D U H G L W G F H K D H T X D Q V I L D F D W H H W Z R H G L V R G †  
K \ S R W K H V L V W H V W V S P S O D I Q G Z R J G V D L Z O R H V G R V G W W M W P L Q K V L H W  
P H D Q I U R P W K H H T X L Y D O H Q I F L F V E Q S O A D I O L U L I E D R W L R Q H V D P S O H  
W R U H M H F W W K H Q X O O K \ S R W K H V L V L V K V H S U B W D E L O L W \ R I

7KH V H W H V W V D U H S K H I R J R H G / S U W D G V K I G H W L Z K H G K W Z R D W H V  
H T X L Y D O H Q F \ E H W Z V H I Q Q W Z F F P U D O V H O J L H Z P L H W K W W K R H S O H T X L U \*  
V H F W L R Q 7 H V W Q L Q R J U H G H E M Y D Z H H Q F W Q Q U I [ I G D W D E D V H D Q C  
Q H Z G D W D V H W I R U W K H H W D R L O P D V E R X W D G I O H P I G V R K R B M Q X W H G  
W K H U H I H U H Q F H V O L V W H G L Q 6 H F W L R Q



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7KHUH ZHUH D WRHVDVVRHVWGLRIHHUTKLVYDIDLHQLHQWXCQDZMDWDFP  
WR WKH UHFRPPHQGDWLRQVURI ZHUH HLOKWHVWGLSLURIDPH  
ZLWK LQVXIILFLHQWSDVRD WSKFRDPSHWDIDFNFJUVHGDSDODWR PD  
\$OO WHVWV ZHZLWSDHQR.UOHCHO RI

7KH UHVXOWV RI WKS DUTXLRQV HDOFH OBMVHGDWR μ3DVV ZLW  
&9† μ3DVV ZLWK ORG &9† UHIHUV WR

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B, J, P, Q, R, S, T, U, V, W, X, Y, Z, 7HVW 5HVXOWV IRU 6ROYD\ )RUPHUO\

	&7'	57'	(7'	(7:	(7:
	6WUHQJWK	)DLOHG E\		3DVV	3DVV
	0RGXOXV	3DVV		3DVV	
	6WUHQJWK	3DVV		)DLOHG E\	
	0RGXOXV	3DVV	3DVV ZLWK ORG &9	)DLOHG E\	
	6WUHQJWK	3DVV	3DVV	3DVV	3DVV
	0RGXOXV	3DVV	)DLOHG E\	)DLOHG E\	
	6WUHQJWK	3DVV		3DVV	3DVV
	0RGXOXV	)DLOHG E\	)DLOHG E\	)DLOHG E\	
	2IIVHW	3DVV	)DLOHG E\		3DVV
	6WUHQJWK	)DLOHG E\	)DLOHG E\		3DVV
	6WUDLQ	)DLOHG E\			3DVV
	6WUHQJWK	,QVXIILFLHQW 'DWD			,QVXIILFLHQW 'DWD
	0RGXOXV	3DVV	3DVV		3DVV
6KRUW %HDP 6WUHQJWK 1R	6WUHQJWK	3DVV ZLWK ORG &9		3DVV ZLWK ORG &9	3DVV )DLOHG E\
2SHQ +ROH &RPSUHVLRQ <HV	6WUHQJWK	3DVV		,QVXIILFLHQW 'DWD	3DVV
2SHQ +ROH 7HQVLRQ <HV	6WUHQJWK	3DVV			3DVV
,QWHUODPLQDU 7HQVLRQ 1R	6WUHQJWK	3DVV	,QVXIILFLHQW 'DWD		3DVV ,QVXIILFLHQW 'DWD
&XUYHG %HDP 6WUHQJWK 1R	6WUHQJWK	3DVV	,QVXIILFLHQW 'DWD		)DLOHG E\ ,QVXIILFLHQW 'DWD
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\$ JUDSKLFDO SUHVH QWUHWXFOV RILDVCK MZGLQ JXUJUH ,Q  
RUGHU WR VKRZ GWKHUMQPHWHVDSKLFQO VFDOH DOO



:DUS &RPSUHVLRQ :&

7KH :DUS &RPSUHVLRQ DWD Qrupdoljhg Zlwk &37  
 VWUHQJWK GDWD 0HDQ 6WUHQJWK NVL  
 WKH 57' FRQGLWLRQ OLQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ  
 57' DQG (7: FRQGLWLRQ XV GDWD 0HDQ 6WUHQJWK NVL  
 ZHUH QRW SURYLGHG IRU WKH 57' DQG (7: FRQGLWLRQ XV  
 YDULDWLRQ ZDV DERYHWK DZKLVFKHPHQW ZHUH &RUGLILHG  
 IURP WKH UHVXOWV IRU WKH 57' DQG (7: FRQGLWLRQ XV  
 LQ 7DEOH DQG IRU WKH 57' DQG (7: FRQGLWLRQ XV

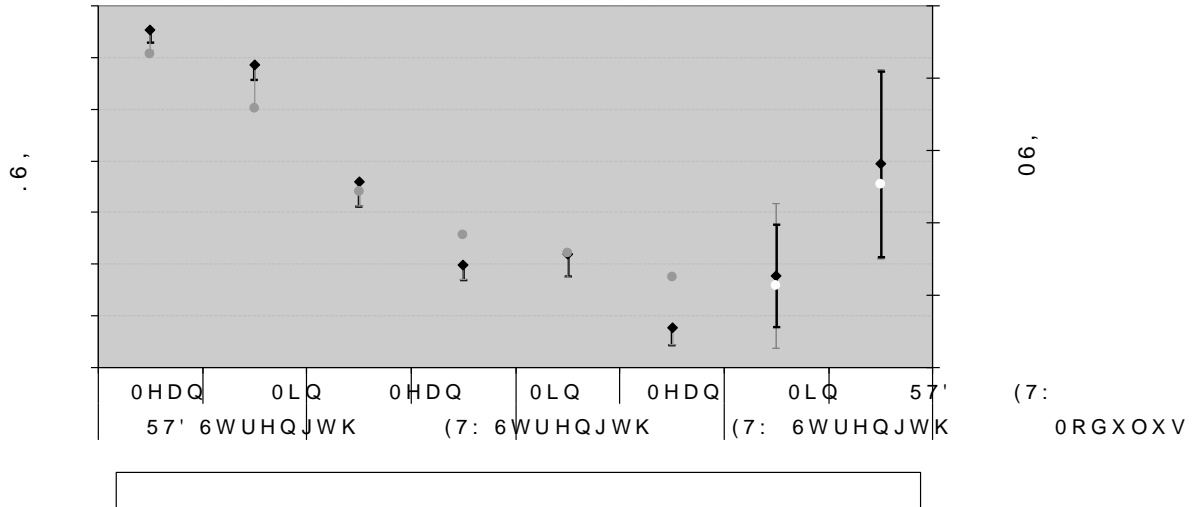
:DUS &RPSUHVLRQ	:& 57' 4	WUHQJWK	(7: D	(7: O	(7: (	(7: T	X	L	Y
'DWD Qrupdoljhg Zlwk &37	0HDQ 6WUHQJWK NVL	6WDQG DUG 'HYLDWLRQ	&RHIILFLHQW RI 9DULDWLRQ	OLQLPXP	ODLPXP	1XPEHU RI 6SHFLPHQV			
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OLQLPXP \$FFHSWDEOH (TXLY 6DPSOH	0LQ								

7DEOH :DUS &RPSUHVLRQ VWUHQJWK 5HVXOWV

4XDO (TXLY 4XDO (TXLY  
 'DWD Qrupdoljhg Zlwk &37  
 0HDQ 0RGXOXV 0VL  
 6WDQG DUG 'HYLDWLRQ  
 &RHIILFLHQW RI 9DULDWLRQ  
 OLQLPXP  
 ODLPXP  
 1XPEHU RI 6SHFLPHQV

)LJXUH LOOXV WPSUHWWRQ V V B HQ QWR XPH DDO XHQVGRQ LG W  
 PRGXOXV PHDQV IRB QWK BPTXOHO DIQ G DWWLB FSTOHL Y D OHH OELPLWV  
 HTXLYDOHQF\ VDP SOHJUD B H E B Z QZ DWK QW G B WTX DOKHL O B W J H  
 OLJKWHU FRORUH G H W U L R B R E C L U V H G U & 9 I R R P S X W D W L R Q V

6ROYD\ )RUPHUO\ \$GYDQFHG &RPSRVLWHV \*URXS 070 & ) 5:  
 \$6 )DEULF &RPSDULVRQ RI /+ &XUH V L R Q H + Z & X L H B L F L Q H L Q D O 4 X D O L I L F  
 7HVV 5HVXOWV IRU :DUS &RPSUHVVLRQ 'DWD 1RUPDOLJHG





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7KH :7 PRGXOXV GD'WHDQMLU RQKPH QW IDLOFHGWMMK MW HETHFLDYDVOH  
 VDPSOH PHDQ YDOXHH WKH X S SHEL R DFFHSWD QKHI OLPLW  
 HTXLYDOHQF\ VDPSDVH PHDQ RYDVKH X S SFFUH SW DEVO HR YDOXH V  
 8QGHU WKH DVVX PSCMLLR QR GR & WR R H WPKRG DWIKUR P RAGXO X' GDW  
 HQYLURQPHQWH SDTXLYG QHQFH WHVW

7KH :7 PRGXOXV GD:WBIQRUUMR QPH QW IDLHQFG WVKVWHE MEYDQH  
 WKH VDPSOH PHDQWEEORZ WKH LORZHUWDFHHSWDQKHI OLP  
 HTXLYDOHQF\ VDPSOH PHDRQ WKOXORLZHFJHS WPLEVO RYDOXH V  
 8QGHU WKH DVVX PSCMLLR QR GR & WR R H WPKRG WKPSS GR XLYDQHLQF\  
 RI WKH PLQLPXIP DFFBQSYDDEXH

)LJXUH LOOXVWULRQHWWWKIQJVKPQVQV DQHGVPDQGPVKKH  
 PRGXOXV PHDQV IRBQWKBIPTXOHO DIQGDWMLR FSTOXLYDKHH OFLPLWV

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)LOO &RPSUHVVLRQ )&

7KH )LOO &RPSUHVVVQBQLGHDVE\LFXQRIG7&B\)\WQLFUFQDHOV\JHG  
 VWUHQJWK GDWDDSEBQVH\W\HVTWV IRUVDIOVWIHRG U7KRIQ)&LWRBBD  
 PRGXOXV GDWD SDVVMB\VHTRXLOADICRHWQWYOM\B7'WFRQGLWKLH (7' R  
 (7: FRQGLWLRQV (7: DPZRGXQRWGDYDLOBEQUHVXQV\IIZHGH C  
 SURYLGHG HRQWKKIGD\WWD EHFDXVH LQHDQVD REIDYB\VLW\KHLFRHZID  
 DERYH ZKLFK PHDQMLMIGD&9 WKNXPORV\HZQW HURRP GLKHHUHV  
 VKRZQ 6WDWLVLVLFVQVQGDQD\K\ZQVLRHUGXWHD VQ\U7HDEOH  
 IRU WKH PRBXLQX7DEGW

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)LOO 7HQVLRQ )7

7KH )LOO 7HQVLRQ GDWD FXUHQBUFDOMJLGRQFDOLJHG VWUH  
GDWD SDVVHG HTXLYDOHQIRXWHFRQKLRVLRQRUPDOWJHG FRG  
GDWD GLG QR\Gp`0•

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8QGHU WKH DVVXPSWLRQ RI WKH P



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/DPLQD 6KRUW %HDP 6WUHQJWK 6%6

7KH 6KRUW %HDP 6VQRHQ QW K PDDWLPHGV 7KHU 6KRUW %HDP  
SDVVHG HTXLYDOHOO WWHM WFRQG LMDLRQ V(7:ERKQW KW L57Q V  
UHTXLUHG WKH XVH & R IP WWHK RGR QLR LSHGQ/G 6VQDDO LWWL EHV XOV  
WKH 6%6 GDWD DUH VKRZQ LQ 7DEOH

6KRUW %HDP 6WUHQJWK	<sup>5 7'</sup> <sub>4</sub> 6%6 X	D	O	(7:	(7:
'DWD DV PHDVXUHG				(	T X L Y
0HDQ 6WUHQJWK NVL					
6WDQGDUG 'HYLDWLRQ					
&RHILFLHQW RI 9DULDWLRQ					
0LQLPXP					
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1XPEHU RI 6SHFLPHQV					
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)LJXUH LOOXVWUJWDIR @WKUHQRVK PPIYDWDQV IRLQWKH  
TXDOLILFDWDRQ WDPHS@FXLYDOHQF\ VDFXOYDOKHFO LPLPSOH  
DUH VKRZQ DV HUWRH EXDQGLWZKHODRQVHU FRORUHG HU  
DUH IRU WKH PRGLLHG &9 FRPSXWDWLRQV



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,Q 3ODQH 6KH DU ,36

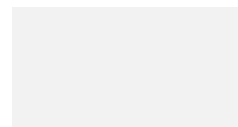
7KH ,Q 3ODQH 6KH DRU B D W D J H G Q R W 36 6WUBIQQVGD V W SDV V  
HTXLYDOHQF\ WHV V FRQQGLW URW K H I G & D' L D G 5RU W

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PRGXOXV PHDQV IR ~~B~~ ~~Q~~ ~~K~~ ~~E~~ ~~P~~ ~~T~~ ~~S~~ ~~X~~ ~~D~~ ~~H~~ ~~D~~ ~~I~~ ~~Q~~ ~~G~~ ~~D~~ ~~M~~ ~~L~~ ~~E~~ ~~F~~ ~~S~~ ~~T~~ ~~O~~ ~~X~~ ~~H~~ ~~L~~ ~~Y~~ ~~D~~ ~~K~~ ~~H~~ ~~O~~ ~~F~~ ~~L~~ ~~P~~ ~~L~~ ~~W~~ ~~V~~



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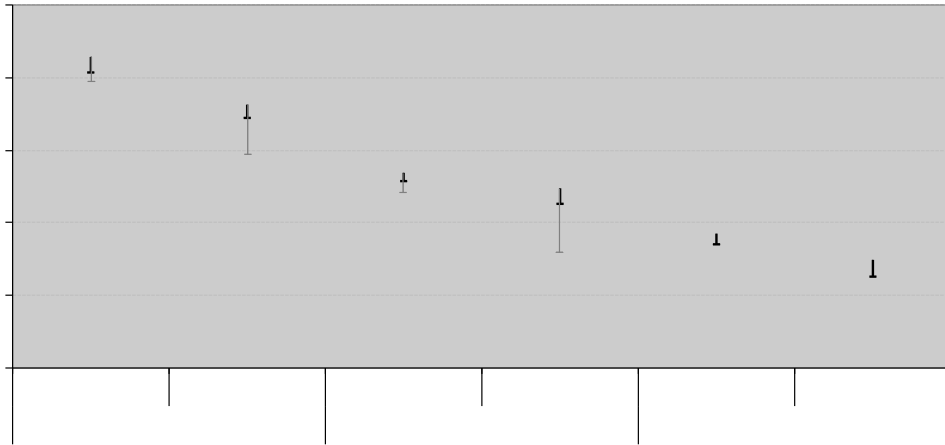
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3 ' 2SHQ +ROH &RPSUHVVLQR 2+&

7KH 2SHQ +ROH &RPSUHVVLQR QHVVLRQLGHV\LFQWVHG \$OH WSHQ+RO  
&RPSUHVVLQR QRUPDOWDGDVWUHQJHWKRVDOKHQ57WDHQV I  
(7: FRQGLWLRQV E(XWFRQGLWLRQKH7KHLLHLZQWVHQVPHQV  
WKH 2+& (7: VWUHQJHWKHVWUHQJHWVIRVRFHQVHLGHVWVLFV  
DQG DQDO\VLV UHVXOWVHQJHWKHVWUHQJHWVIRVRFHQVHLGHVWVLFV

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)LJXUH LOOXVWURDWH & RVPISH HZSVILQR QVVWUQH QJLQKPPXPD Q  
 YDOXHV IRU WKH TXDODQGF DWKLR BTXD PFKOHQEP LWDVSBH  
 HTXLYDOHQF\ VDP SOHMURH EEBZQZ DWKQW&DWDX DOKHLORWJH  
 OLJKWHU FRORUHJ HWKLR BRELUVHGU&9IRRPSXWDWLRQV  
 lb U0Q - -5VD P 0lb U0Q -"p p`0• U`-% ,ap`1 Á- ðUV ibP 6 ap





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,QWHUODPLQDU 7HQVLRQ ,/7 DQG &XUYHG %HDP 6WUHC

7KH ,QWHUODPLQDUYTHGV%RQPDQWU&XJQRUBDOWD]HGUH7QRW/7  
 VWUHQJWK GDWDDSBQVHWHVWV IRU ERWKRQGHW5ZRQQG 7KH  
 &%6 GDWD SDVVHG HTXLYDQHQ57' WRQVWHLRQ: ERWQRWLRQ  
 ORGLILHG &9 UHQXW SURZYLHG GWHBHQWK ,GDWD IURP HLWKH  
 DQG WKH &%6 GDWDQGLWWRQ 57FBRVHRWKDUEBMLRQLZQWDE  
 ZKLFK PHDQV WKDW9WKHV RQVMIZHGHBRQPRVGLHIBHMQOWIV VK  
 7KHUH ZDV LQVXIIWFLHQWUGHWQWQWQBQWVLYH 6WDWLWV  
 DQDO\VLV UHVXOWWKDU,H7VBRQ&PRUGDWD LQ 7DEOH

	4XDO	(TXLY	4XDO	(TXLY	4XDO	(TXLY	4XDO
'DWD DV PHDVXUHG							
0HDQ 6WUHQJWK NVL							
6WDQGDUG 'HYLDWLRQ							
&RHILFLHQW RI 9DULDWLRQ							
0LQLXP							
0D[LXP							
1XPEHU RI 6SHFLPHQV							
5(68/76							
0LQLXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ							
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02' &9 5(68/76							
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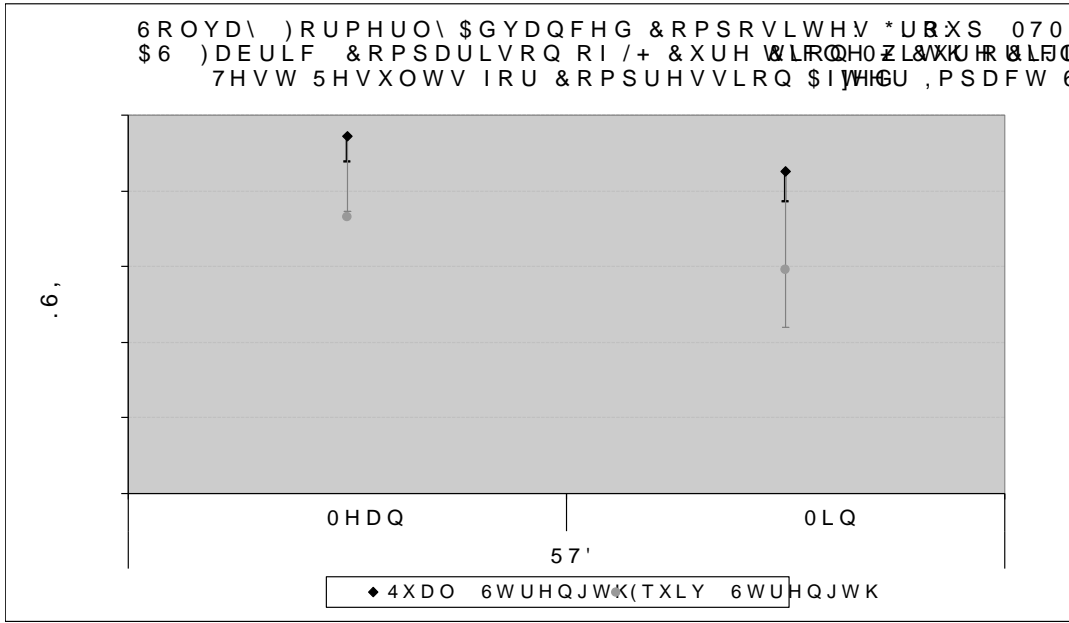
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&RPSUHVVLQR \$IWHU ,PSDFW &\$,

7KH &RPSUHVVLQR \$DWLHUQRSDWLGHDGWFNFQXUHV 7SIOH WK  
&RPSUHVVLQR \$IWHUH,PSDFWHQRWRDGDHMDXIGLGGORW\SBVWK  
57' FRQGLWLRQ 7KHUHQZDGDVQDXIRUFRQVLUHVXHQVFRQIEOXV  
6WDWLWLFV DQG DQ\$Q\WVUHJMKIOWRDEOH VKRZQ

)LJXUH LOOXVWUHDWHLRQVSDHWRVPSHIDQJWDKQE PLQLPXP  
 YDOXHV IRU WKH TXDODQLG DWKLRQ TXDQFSDHQRERLWVSDH  
 HTXLYDOHQF\ VDP SOHMDRH EEBZQZDWKQWGDWTD DOKHLORWJH  
 OLJKWHU FRORUHGUHWKLRQREGLVHGU&9IRRPSXWDWLRQV



)LJXUH &RPSUH,PSDFQ \$IWHIDQV PLQLPXP HQFEGGO (TPXLWV



6XPPDU\ RI 5HVXOWV

\$OO WKH HTXLYDOHQFH FRPPRQ XULWRQ VZSWREDA SHO, LWUURUR I  
 DFFRUGDQFH ZLWK )\$\$U' \$R\$W DQG &0+ \* V,MFWLRQ  
 FRPPRQ WR REWDLQ HDYHLZDUI DLYHQXU XV YLDOHQF\SSBROUHP  
 LQYROYLQJ PXOWLSDRSLQVGHSRISDHLQWLFQWKHQ TXLYDOHQF\  
 GDWDVHW LV WUXHTXGDIQWEEDQ RORQVWRVREWVZHQHDS SUR [I  
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7KH DVVXPSWLRQ RI ,QGHSHQGHQFH

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 H[SHFWHG WR EH SRVLWLYHO\ FRUUDWHG

+RZHYHU WKH FRPSWVFRQVRQMFDQFRHQWHUWVWVWVH QRWK  
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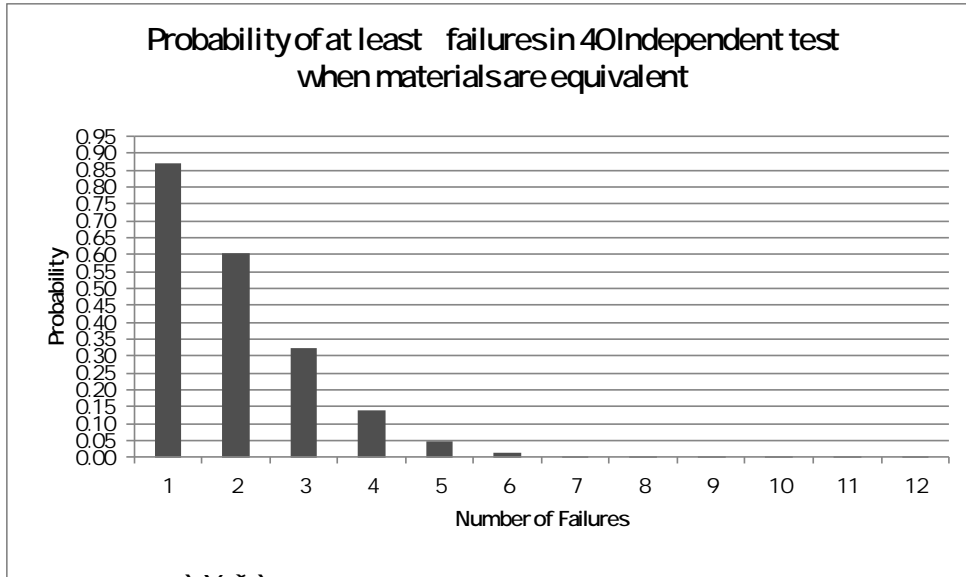
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