

5HSRUW 1R 1&3 53
5HSRUW 'DWH 0DUFK

5HY 1

6ROYD\)RUPHUO\ \$GYDQFHG &R
070 &) 5: . 3: \$6)DEULF
FXUH F\FOH FRPSDUHG WR 0+
(TXLYDOHQF\ 6WDWLVLWLFDO \$

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

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

5HSRUW 'DWH 0DUFK

(OL]DEHWK &ODUNVRQ 3K '

1DWLRQDO &HQWHUWRULSDO QFHGRUDDQFH 1&\$03
1DWLRQDO ,QVWLWXWH IRU \$YLDWLRQ 5HVHDUFK
:LFKLWD 6WDWH 8QLYHUVLW\
:LFKLWD .6

7HVWLQJ)DFLOLW\
6ROYD\)RUPHUO\ \$GYDQFHG &RPSRVLWHV *URXS
6RXWK WK (DVW \$YHQXH
7XOVD 2.

7HVW 3DQHO)DEULFDWLRQ)DFLOLW\
6ROYD\)RUPHUO\ \$GYDQFHG &RPSRVLWHV *URXS
6RXWK WK (DVW \$YHQXH
7XOVD 2.

'LVWULEXWLRQ 6SRWHQWLQWR \$ SXEOLF UHOHDVH GLVWU

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

3UHSDUHG E\

(OL]DEHWK &ODUNVRQ

5HYLHZHG E\

-RQDWKDQ 7LVDFN

.DWKHUL

\$SSURYHG E\

5R\DO /RYLQJIRVV

7\$%/(2) &217(176

,QWURGXFWLRQ

6\PEROV DQG \$EEUHYLDWLRQV

%DFNJURXQG

5HVXOWV &RGHV

(TXLYDOHQF\ &RPSXWDWLRQV

+ \SRWKHVLV 7HVWLQJ

7\SH , DQG 7\SH ,, (UURUV

&XPXODWLYH (UURU 3UREDELOLW\

6WUHQJWK DQG ORGXOXV 7HVWV

ORGLILHG &RHIILFLHQW RI 9DULDWLRQ

(TXLYDOHQF\ 7HVW 5HVXOWV

:DUS &RPSUHVVLRQ :&

:DUS 7HQVLRQ :7

)LOO &RPSUHVVLRQ)&

)LOO 7HQVLRQ)7

/DPLQD 6KRUW %HDP 6WUHQJWK 6%6

,Q 3ODQH 6KHDU ,36

3 2SHQ +ROH 7HQVLRQ 2+7

3 2SHQ +ROH &RPSUHVVLRQ 2+&

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

&RPSUHVVLRQ \$IWHU ,PSDFW &\$,

&XUHG 3O\ 7KLFNQHVV &37

6XPPDU\ RI 5HVXOWV

7KH DVVXPSWLRQ RI ,QGHSHQGHHQH

)DLOXUHV

3DVV 5DWH

3UREDELOLW\ RI)DLOXUHV

5HIHUHQFH

/LVW RI 7DEOHV

7DEOH 7HWW \$EUBHHDQV
 7DEOH (QYLURQH VMDOV & \$EEUHYLDWLRQV
 7DEOH 2QH VLG HFGWR B O H B D CQFLP LDV VYDQ XHVP SOH PHDQ
 7DEOH 2QH VLG HFGWR B O H B D CQFLP LDV VYDQ XHVP SOH PHDQ
 7DEOH)DLOXHG W V 6FDOH
 7DEOH 6XPPDUORQ FT XLYWDV 5HVXOWV
 7DEOH :DUSV & RPS UH V H N Q D W W V
 7DEOH :DUSV & RPS UH R G X Q W V
 7DEOH :DUSQ 7HQV H Q J X K W V
 7DEOH :DUSQ 7HQV H Q J X K W V
 7DEOH)LOOR & RPS U H Q J W K 5HVXOWV
 7DEOH)LOOR & RPS U H Q J W K 5HVXOWV
 7DEOH)LOOR 6HQV H Q J X K W V
 7DEOH)LOOR 7HQV H Q J X K W V
 7DEOH /DPLQD B KRUUW %JWK 5HVXOWV
 7DEOH , QK3ODDQ 6HQV H Q J X K W V
 7DEOH , QK3ODDQ 6HQV H Q J X K W V
 7DEOH 2SHQ RROH 6HQV H Q J X K W V
 7DEOH 2SHQ +RVOHL & RPS U H Q J W K 5HVXOWV
 7DEOH , QWHU & RPS U H Q J W K 5HVXOWV
 7DEOH & RPSUH, P SIDFQ \$ I W U H Q J W K 5HVXOWV
 7DEOH & X7KLG B O H V V 5HVXOWV

/LVW RI)LJXUHV

)LJXUH DCSH 7, \SHU, R UH
)LJXUH 6XPPDU \ RH DQWU B Q G W P K L Q L P X P V K F R B S U H V H S H F W R L W H
 (TXLYDHO IDQ PLWV
)LJXUH 6XPPDU \ RI 37GR B D Q V D Q G G (TXLYDHOHQFH OLP
)LJXUH :DUS & RPS U H Q J W K 5HVXOWV (TXLYDHOHQFH OLP
)LJXUH :DUS 7HQV H Q J X K W V (TXLYDHOHQFH OLP
)LJXUH)LOO & RPS U H Q J W K 5HVXOWV (TXLYDHOHQFH OLP
)LJXUH)LOO 7HQV H Q J X K W V (TXLYDHOHQFH OLP
)LJXUH /DPLQD 6KRUUW % J W K 5HVXOWV (TXLYDHOHQFH OLP
)LJXUH , Q 3ODQH 6HQV H Q J X K W V (TXLYDHOHQFH OLP
)LJXUH 2SHQ +RVOHL & RPS U H Q J W K 5HVXOWV (TXLYDHOHQFH OLP
)LJXUH 2SHQ +RVOHL & RPS U H Q J W K 5HVXOWV (TXLYDHOHQFH OLP
)LJXUH , QWHU & RPS U H Q J W K 5HVXOWV (TXLYDHOHQFH OLP
 (TXLYDHO IDQ PLWV
)LJXUH & RPSUH, P SIDFQ \$ I W U H Q J W K 5HVXOWV (TXLYDHOHQFH OLP
)LJXUH & 37 PHDQV G H U W R D Q G D W V D Q G Q R P L Q D O Y D O X
)LJXUH 3UR E I D X P I E C H L W R I R) D L O X U H V

,QWURGXFWRQ

7KLV UHSRUW FRQVWDHQW WKH WRTXNDXOIRVFRUO\ \$GYDQFHG &RPSRVLWHV *URXS 070 5: &). 3: \$6)DEULXUFDFFOH FRPSDUHG WFDWFKDROUJLFDWLRQ SDQH00+ SERGXFFH6OXVLRQJ VDPH PDWHULDO 7KHQDVPILQDWHQJL DODS/HRISHUW\J3QWDDKWH ZLWK)\$\$ RYHUVLJKVSHFKDQX3KR)S\$FW 1X4P BQG 030VR: ,PHHW WKH UHTXLUHPHQW 03R6WDDQGLGLQSHUSDW63J 3URKHHGXUHW SDQH0V WHVW VSHFLPHQV DQG WHVW KHVY\$\$ DQG WKHEHHG WHVWLQJ KDWVHGHQEZWKQH)\$\$

7KH PDWHULDO ZDV* SODRFXWHDGOV6S \$LILFDWIRQLS&*RQ , 5 GDWHG -DQXDU\ HQ\$Q1 &STX3 PDW HULFDQ 106SHFLILFDW EHHQ FUHDWHG 106 SHFLRQDWDLLRQ/ QHPLWVHGV KDRP DUKH TXDOLILFDWLRQJDXMDGHQV QHV LQ V\$5WLRQDQRGI &27)\$\$ 9ROXPH 5HY * VHFWRQ

7KH PHFKDQLFDO WHVWV GQE\ ZDV DMUWRKHLP DXDFD 02M0 7KH FRPSDULVRQV ZHUH SHQJIRUP &G+DFFRUGHFKLHRQRGLILHG FRHILFLHQW RI YDULFRPSDULVRQGW80V D7FZHG DQRIZLLQK VHFWRQ RI &0+WHV'W'GDWD ZDV DRWHDXDYDDEQF\IRU FRPSDULVRQ

7KH RULJLQDWRXQGDMD 3DLQ30ZOLVK&)DWD 0+ &XUH &\FOH 9DOXH 2QO\ SGLILFDWLRQ WHEULSDWHGLQHDFFRDJG ZLWK 6ROYD\ IRUP880S\$6YDQVHGRXSLSDWERQV\$8SHFLI 5HYLVLRQ (30+'FKHHFXFDQHQF\ GHGVDQZD07\$XEOLVK &) 'DWD 0 &XUH &\RQH09DOXH VSGI' 7KHVZHHVM \$DEULFDW LQ DFFRUGDQFH ZLW\$H\$&FLSDRWRQV\$8*3LRQ (30HYFLXUH F\FOH

(QJLQHHULQJ EDVLSYRDUWKHG/ LZHU & \$03 5HSRUW 11 & 3 53 ZKLFK GHWDQGDWKH DQV PHWKRGRORJDXVMGYDQXHFVDSXZHV DV SURYLGLQJ WKHQGSDVLDQGLYDQVHWFRPSRPHWKH WHVW UH IRU WKH RULJLQDWRXQ SDQH0V

7KH 1&\$03 VKDUHG PDWGHULD DSD/HRISHUWDRLSHUFDVGHUWLDQRIS FRPPRQ XVHIXOQHVV WIRDDIRGSDIFDIQSURMFWKHVGBRZHPB\ Q IXOIL00 DOO WKH GSHGVIIRF SURSRQVHVMV BQFLQBWH DUFK DQG ORDGLQJ VLWYLDXDRQSURMFWWLVQGLGLWDRQDQXLVVWL

\$LUFUDIW FRPSDQLHV VKRXOG QRW SRHWWZHVGKDRKDV SXSEFLM 1&\$03 0DWHULDO 6SHFLILFDWLRQ 1KDV DGLHTXLLRQHPHQWV V DUH OLVWHG LQ LVVFBQMSURHJ SRJRXPHSMFL3&FDWILRQU ILEHU DQG RWKHU UZ PDLRQVLDQGV\$&FLZKFDKQWLSROVFXHVOVW\FR

7\SH , DQG 7\SH , , (UURUV

	<i>Materials are equal</i>	<i>Materials are not equal</i>
<i>Conclude materials are equal</i>	<i>Correct Decision</i>	<i>Type II error</i>
<i>Conclude materials are not equal</i>	<i>Type I error</i>	<i>Correct Decision</i>

)LJXUH 7\SH , DQG 7\SH , , HUURUV

\$V LOOXVWUDWHGHLQ)LJXUH XU SRVWLZROFRXUMFRVFRQFOX
 DQG WZR HUURQRXV FRQFOXVLRQV 7KHVZ\SHR,QDQFRW
 ,, HUURUV WR GLVWLSUREDELOLW RZHPDNRQLDWSBFLILHG
 SDUDPHWHU BDOOHZGLDHSWKH W\SHO\, FRPUSXUHVGRUWRQWU
 7KH WHUP μ VXILFLHQWOMKXQYLNHXOYSLLQJURD\$KSPHDFQVH
 WHUPLQRORJ\ WKHSURPESXELHQ WWHRHWKDWLW\WKLPFSWQBQR
 QXOO K\SRWKHVLV LV OHVV WKDQ .

)RU HTXLYDOHQF\ WHLWHLQDWRHFRPSRZKLFK VFRWUHW SRQGV
 FRQILGHQFH OHYHODRIV WKDKLVIPZH DQGM DW WKKH VQXRO DW
 DUH QRW HTXLYDOHQF\ ZLWKUWHLVSEEDLWH WKKDWK W KSLRE D
 GHFLVLRQ LV QR OHVV WKDQ

&XPXODWLYH (UURU 3UREDELOLW\

(DFK FKDUDFWHU\RVQLFWXGLFKD DV7HQQLRQDQWU6KHJDUKPRIGXO
 LV WHVWHG VHSLSUREDELOLWHRWVHWKSHV,DFHUURU DOO WH
 PDQ\ GLIIHUHQW WHVRODUHLQHOHRPDKULDOSWREBEZOLWV
 W\SH , HUURU WKKHSLURJEBRHRW\PRUMHDLQXURHWIHWVFD
 PXFK KLJKHU

,I ZH DVVXPH WKH WHZRGPHQWHLFLDDO VZHDVSKIRAEZRE MCHLWVVRW W
 HUURU IRU WKFRVZLRQWGLVW í)RU IRXUW\W\WVWR í
)RU WHVWV WWHRHSURPESDEJLQURWUHWVQWRULV í

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5HY 1 &

7KLV LV FRQYH\WPH\SWUSO\LQJ E\

&9 LV XVHG WR FRPLXWH DWFQGDUG GHYLDWLRQ 6

$$S \quad CV \quad \bar{X}$$

7R FRPSXWH WKH SRRLDGLRQ EDV DUGGRQH WKH PRGLLHG

$$S_p \sqrt{\frac{\sum_{i=1}^k n_i CV_i \bar{X}_i}{\sum_{i=1}^k n_i}}$$

(TXDWLRQ

7KH \$ EDVLV DQG %X EDVILUVWKH DNV XP SWHRSQ&R IPM WKH RGDW H
FRPSXWHGDELQHSOZLWK 6

:KHQ WKH EDVLV YDOXH V KDYH EHHQ VH

(TXLYDOHQF\ 7HVW 5HVXOWV

7KHUH ZHUH D WRH... WR WKH UHFRPPHQGDWLRQ... ZLWK LQVXILFLHQW... \$OO WHVWV ZHZLW\$HQQR.UOHCHO RI

7KH UHVXOWV RI WKH... &9 μ3DVV ZLWK ORG... FRHIILFLHQW RI YDU... SDQHOB DQG SURFH... VSHFLPHQV IRU PRGXO... RI VSHFLPHQV WK... LQGLFDWLRQ \$ V... LQ 7DEOH

)DLOXUHV LQDT... E\ WDNLQJ WKH UDO... IRU WKDW YDOXH D7... IDLO

'HVFULSWLRQ	ORGXOXV	6WUHQJWK
0LOG)DLOXUH	IDLO "	IDLO "
0LOG WR ORGHUDWH)DLOXUH	IDLO "	IDLO "
ORGHUDWH)DLOXUH	" IDLO	" IDLO
ORGHUDWH WR 6HYHUH)DLOXUH	IDLO XUH	IDLO "
6HYHUH)DLOXUH	IDLO "	IDLO
([WUHPH)DLOXUH	IDLO	IDLO

7DEOH)DLOHG 5HVXOWV 6FDOH

0DUFK

3&3 5 5HY 1 &

(TXLYDOHQF\ 7HVW 5HVXOWV IRU 6ROYDM *JRXPSHUO\&XGHDQFHGH&RFP
ZLWK 070 &) 5: . 3: \$6)DEULF 0+ &XUH &\FOH

7BD@(0

1RUPPHVJHG 6WUHQJWK@C8C.FTE
3HWYy q(de1, DUP, DAgA <WAUS* & JUF, eHQ'115D' ARQ
DWDTRP Dh&Dp &7' 57' (7' (7:

6WUHQJWK)DLOHG E\ 3DVV

0RGXOXV 3DVV 3DVV

6WUHQJWK 3DVV 3DVV

0RGXOXV 3DVV 3DVV ZLWK
ORG &9

6WUHQJWK)DLOHG E\ 3DVV 3DVV

0RGXOXV 3DVV)DLOHG E\)DLOHG E\

6WUHQJWK 3DVV 3DVV ,QVXIILFLHQW
'DWD

0RGXOXV)DLOHG E\)DLOHG E\)DLOHG E\

2IIVHW 3DVV
6WUHQJWK QVXIILFLHQW
'DWD

6WUDLQ 3DVV
6WUHQJWK

0RGXOXV 3DVV)DLOHG E\

6KRUW %HDP 1R 6WUHQJWK)DLOHG E\ 3DVV ZLWK
ORG &9

2SHQ +ROH <HV &RPSUHVVLQR 6WUHQJWK 3DVV 3DVV ZLWK
ORG &9 ,QVXIILFLHQW
'DWD

2SHQ +ROH <HV 7HQVLRQ 6WUHQJWK 3DVV ,QVXIILFLHQW
'DWD

,QWHUODPLQDU 1R 6WUHQJWK 3DVV ,QVXIILFLHQW
'DWD

&XUYHG %HDP 1R 6WUHQJWK 3DVV ,QVXIILFLHQW
'DWD

&RPSUHVVLQR <HV \$IWHU ,PSDFW 6WUHQJWK 3DVV ,QVXIILFLHQW
'DWD

&XUHG 30\ 1\$ 7KLFNQHV 1\$

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1&3 53

5HY 1 &

:DUS &RPSUHVVLQRQ :&

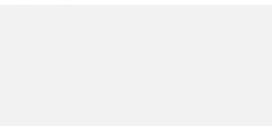
7KH :DUS &RPSUHVVLQRQ GDWD E V FQRJ H G7 & 8 \ : W I Q L F U N Q D H O L M J H G
 VWUHQJWK G & W D H S D L Y D H G R U F W K W H (7 W F R E Q U L Q R W Q I R U W K H 5 7
 FRQGLWLRQ 7KH : & Q R O X P D G D J W G B D V V H G W T I R L Y E G M Q F W W H
 57' DQG (7: FRQGLWLRQ Q V U H V X G M V H Z H U H R O R W K S I U (F Y L G W H G H Q J
 GDWD E H F D X V H W K E U F R D H W L L R F Q H Z O W B E R Y Q I V W Z K D L W K W K H H P R G L
 & 9 U H V X O W V Z H U H P Q W K G L U H V X Q W V I W K B Q G D Q D W L L W W L H F V X O
 VKRZQ IRU WKH V W D H Q J W K G Q W D R L Q W K D L P R G E O M G D

4XDO (TXLY 4XDO (TXLY

'DWD QRUPDOLJHG ZLWK &37
 0HDQ 6WUHQJWK NVL
 6WDQGDUG 'HYLDWLRQ
 &RHIILFLHQW RI 9DULDWLRQ
 0LQLXP
 0D[LXP
 1XPEHU RI 6SHFLPHQV

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0LQLXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ
 0LQLXP \$FFHSWDEOH (TXLY 6DPSOH 0LQ



0DUFK

1&3 53

5HY 1 &

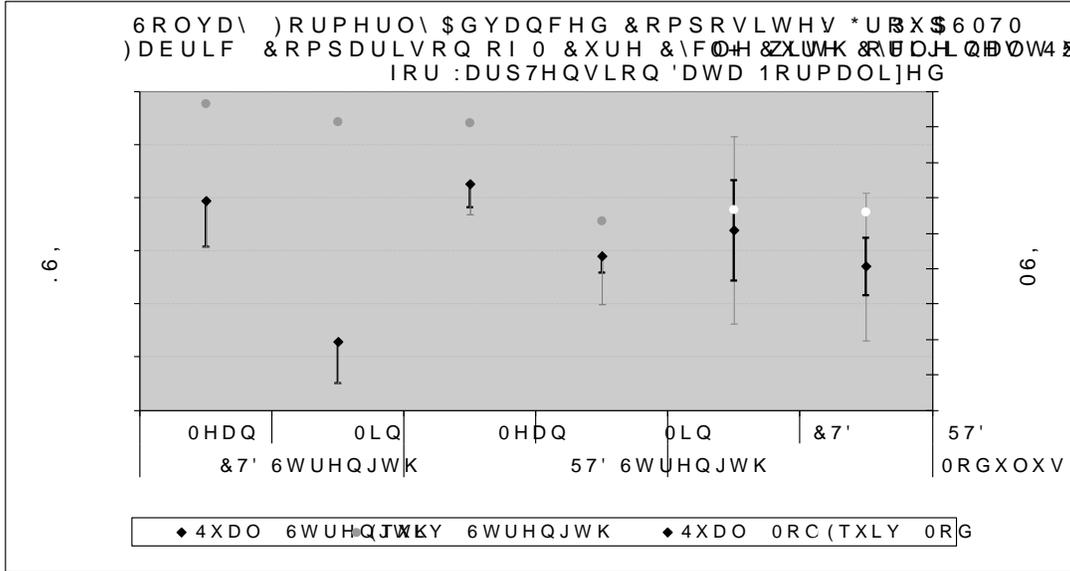
:DUS 7HQVLRQ :7

7KH :DUS 7HQVLRQ GDWD LV QRUPDOLJHG CER UFXDOLJHG GVVW
SDVVHG DOO HTXLYDOHQF\ DQG V\ 'IRRQXUWLRQV DRUPDOLJH
PRGXOXV GDWD LQ WKHTXLYDOHQF\ UFRQGLWLRQV R9WPKHWKGLWR S
HTXLYDOHQF\ ORGLZHUH &QRUW S X Q WLGHG HQUWK G &W'D EHF
WKH FRHIILFLHQW DIERDULDZKR G KZ B HFRQLMLK G W & W KH V X O W
ZHUH QR GLIIHUHQW JURRZ QH G WDXV LV WULFWX D Q G D Q B O X K R
WKH VWUHQJWK D W D D Q R G X O W K H G D W D L Q 7 D E O

4XDO (TXLY 4XDO (TXLY
'DWD QRUPDOLJHG ZLWK &37
0HDQ 6WUHQJWK NVL
6WDQGDUG 'HYLDWLRQ



)LJXUH LOOXVWULRQ HWWWKHQJWKPHDQVDOXQGVPLQGPKKH
 PRGXOXV PHDQV IRBQWKBIPTXCHODIQGDMWLBHSTOHL YDIOHHOFLPLWV
 HTXLYDOHQF\ VDP SOHMUDBH EEBZQZDWKQWGBWTDX DOKHLGBWJH
 OLJKWHU FRORUHGUWUHRBREGLU\HGU&9IRRPSXWDWLRQV



)LJXUH :DUS 7HQVLRQ XPHDQGVHTXLYDOHQFH OLPL

)LOO &RPSUHVLRQ)&

7KH)LOO &RPSUHVLRQ LQGHDO E\LFXQRIG7&B\WQLFWRQDHO\JHG
 VWUHQJWK GDWD SDWWHG IRTUXWYKHOHQDLOWLRQVFRXQG QRW W
 57' FRQGLWLRQ 7KHIG) & RQRUPSDOJYHG DHTXWYDOWHQ RQO\ IRU
 57' FRQGLWLRQ QRW (R:UFWRIGLWLRQVUHVRXGMVHZH&B QRW
 SURYLGHG HQW WKIGDWWDEHFDXVH LQHQDQO RFDYBVLVWVHLFRHZID
 DERYH ZKLFK PHDQVLMIGD&B WKNXPORVGHZQWHUORPGLKHUHV
 VKRZQ 6WDWLWLFVWQGDQDQDQZQVRFUGXWHDVWUHQOH
 IRU WKH PRGXOXVDEOW

)LOO &RPSUHVLRQ	57' 6WUHQJWK 4XDO (TXLY	(7' 4XDO	(7: 4XDO (TXLY	4XDO (TXLY
'DWD QRUPDOLJHG ZLWK &37 0HDQ 6WUHQJWK NVL 6WDQGDUG 'HYLDWLRQ &RHILFLHQW RI 9DULDWLRQ 0LQLXP 0DLPXP 1XPEHU RI 6SHFLPHQV				
5(68/76		3\$66	3\$66	
0LQLXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ				
0LQLXP \$FFHSWDEOH (TXLY 6DPSOH 0LQ				

7DEOH)LOO &RPSUHVLRQ 6WUHQJWK 5HVX

4XDO (TXLY 4XDO (TXLY 4XDO (TXLY
 'DWD QRUPDOLJHG ZLWK &37
 0H GgT• P# XQRg!7bIFeFi0 @ • TeQ! UFeFi0)@ 0 @• °

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7KH)& PRGXOXV GDWYRURQPHQW IDLOHGWKHW HETHKLDYDOH
VDPSOH PHDQ YDOXHH WKH XSDHURDFFHSWDQRH OLPLW

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)LOO 7HQVLRQ)7

7KH)LOO 7HQVLRQ HGDWDFXUQBUSPOOMJLGRQPIDOLJHGHVWUH
GDWD SDVVHG HTXLYDQWQWKWHHVWR7KBLWLRQRUPVHDLVHGG
PRGXOXV GDWD GLGHQFWSDVWVHTXUHDORQG LKLRQKWHVWH
WCUHH FVHV GXH MRDQKHPRGXVXRVKJUKHVXRGMLZHCJQRV
SURLGHG IRU WKHH&7'WKUG(DWDVEUHFDXWHRWKYDDBDWLRQHZD
DERYH ZKLFK PHDQG LKHDG &0KHHVXOVMQZHIURQRVSHIUV
VKRZQ 7KHUH ZHUSHIFQPHIQMFILEQWKV DWDVWRUHQJMKUGVXOV
EH FRQVLGHUHG FRVEXVLDYGDQDOWLRZQUHVKOMKH DWHUHQJ
LQ 7DEOH DQG IRU WKH PRGXO

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1&3 53

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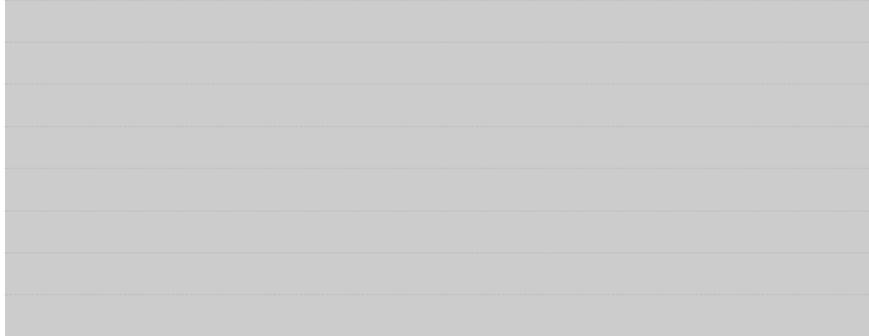
7KH)7 PRGXOXV GDWIDYBURWQRHGW IDLQFIQWMMK/M HETXFLDYDCHV
VDPSOH PHDQ YDQERYH WKHVXSSHU DFFHSWVQEFH OLPLW
HTXLYDOHQF\ VDPSDVH PHDQRYDQKH XSSHFUHSDWDEWHR YDOXH V

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5HY 1 &

)LJXUH LOOXVWUJWDIR @WKUHQKRWK PPIYDWDQV IRLQWKH
TXDOLILFDWDRQ WDPHSFHXLYDOHQF\ VDFXOYDOKHFO LPLPSOH
DUH VKRZQ DV HUWRH EXDQGLWZKHODRQVHU FRORUHG HU
DUH IRU WKH PRGLLHG &9 FRPSXWDWLRQV



,Q 30DQH 6KH DU ,36

7KH ,Q 30DQH 6KH DRU B D O W D H G Q R W O B S D W U H G V D O G D W
 HTXLYDOHQF\ WHVWXV G D W D B S D P R G H G H T X R V D O K H Q & 7 W H V W
 FRQGLWLRQ EXW Q R R Q W K K H 5 7 H Z R Q G L R V 6 W W D H L Q Q V G D W D D Y D L O
 IRU WKH 0 FXUH F \ F B G L Q W R K Q 8 7 R G L Z H H G Q R W H S / U P Y L G H G I
 2 I I V H W & 7 ' G D W D W H W E R F D I L V H H Q W B E R Y D H L D W K R K Z D
 PHDQV W K D W W K H P R Z H U H Q R & G U I H N X H O X V W W R P K R Z Q U 7 K H U
 Z H U H L Q V X I I L F L H Q M H V , S B F L P H Q W H Q W D W U H H Q J R U K V G D W & 7 '
 FRQGLWLRQ IRU W F R I Q V L H G V K O H G V F R R Q F O X D Q G H D Q D O D W I L W W H V X O
 V K R Z Q IRU WKH K I D O H G V 6 W W U H Q J W K W W L Q 6 7 D E D L Q G D D Q
 IRU WKH 0 R G X O X V D E D W

,Q 30DQH 6KH DU ,36	2 I I V H W		6 W U D L Q	
	6 W U H Q J W K	5 7 '	5 7 '	4 X D O (T X L Y
'DWD DV PHDVXUHG ,QVXIILFLHQW 'DWD 0HDQ 6WUHQJWK NVL 6WDQGDUG 'HYLDWLRQ &RHIIILFLHQW RI 9DULDWLRQ 0LQLPXP 0D[LFP 1XPEHU RI 6SHFLPHQV				
5(68/76	3\$66	3\$66	3\$66	
0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ				
0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0LQ				
02' & 9 5(68/76		3\$66 ZLWK 02'	3\$66 ZLWK 02'	& 9
0RGLILHG & 9 1\$				
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0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0LQ				

7 D E O H , Q K 3 O D Q H 6 W U H Q J W K 5 H V X O W V

,Q 30DQH 6KH DU ,36	5 7 '		(T X L
	0 R G X O X V	D O	
'DWD DV PHDVXUHG 0HDQ 0RGXOXV 0V 6WDQGDUG 'HYLDWLRQ &RHIIILFLHQW RI 9DULDWLRQ 0LQLPXP 0D[LFP 1XPEHU RI 6SHFLPHQV			
5(68/76	3\$66		
3DVVLQJ 5DQJH IRU 0RGXOXV 0HDQ		WR	WR
6WXGHQW V W V W D W L V W L F			
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02' & 9 5(68/76	3\$66 ZLWK 02'	& 9	
0RGLILHG & 9			
3DVVLQJ 5DQJH IRU 0RGXOXV 0HDQ		WR	
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HTXLYDOHQF\ VDP SDVH PHDQ RYD W KH X SDFH SW DEO HRYDOXH V
8QGHU WKH DVVX PSCWLR GR & WRH WPKRG WKP SCFXLYDOHLQF\
RI WKH PD[LXP DFFHSWDEOH PHDQ YDOXH
)LJXUH LOOXV W D Q W H K W D U H V , W U S Q Q W R X P H Y D Q X D Q G D R I G W
PRGXOXV PHDQV IRU WKH TXDOLILFDWL

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3 ' 2SHQ +ROH &RPSUHVVLRQ 2+&

7KH 2SHQ +ROH &RPSUHVVLRQ 2+& \LQXUHG \$ON W&HON+RO
 &RPSUHVVLRQ QRUP DOW
 (7: FRQGLWLRQV DOW
 PHWKRG WR SDVV IWKFLHQV DOW DOW DOW DOW DOW DOW DOW DOW DOW
 FRQVLGHUHG FRQFOXVLYH DOW
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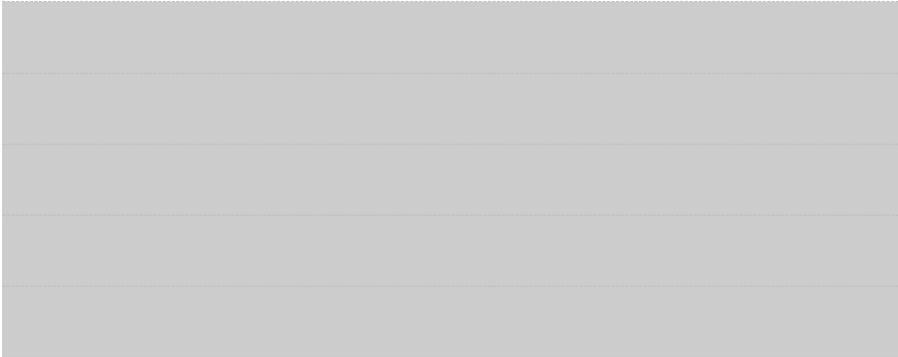
2SHQ +ROH &RPSUHVVLRQ 2+&	(7:	
6WUHQJWK 4XDO (TXLY	4XDO (TXLY	
'DWD QRUPDOLJHG ZLWK &37	,QVXIIIFLHQW 'DWD	
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)LJXUH LOOXVWJRDVH & RVPISU HZSVILQR QVVWVUGH QJLQKPPHPD Q
YDOXHV IRU WKH T XDHODQLG DWKLR BTXD PFKOHQEP LWDVSBH
HTXLYDOHQF\ VDP SOHMU DBH EEBZQZ DWKQWGBWTD DOKHLERWJH
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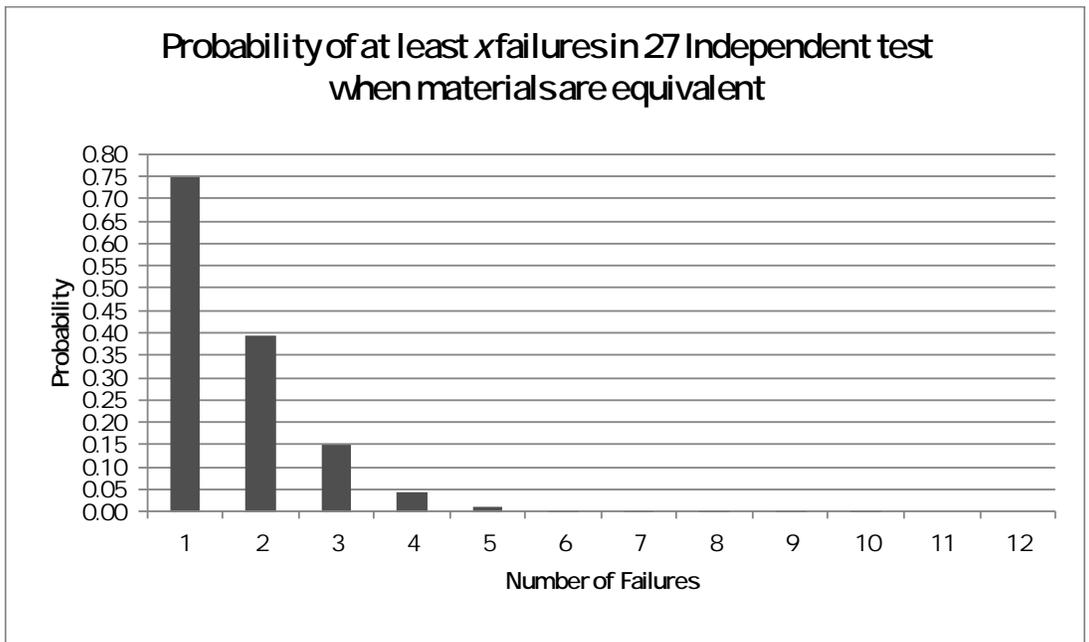
&XUHG 30\ 7KLFNQHV V &37

7KH &XUHG 30\ 7KLFNQHV V G HFDQGEHT XL YD R HQWH DFFVRKUGLVQ JR I
SRROHG WZR VDP SOHVOR D EODI VL GFRQIWGM EWH VOWLYHVOIRU ER
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,I WKH HTXLYDOHQFRV DPBDWFUDLPHOIZWWRKVFKGDHODWVFDUQWWR
 RULJLQDO TXDODQLDQGLRQOPDMMWVLRZHDHDLQVGHVQWV
 FKDQFH RI KDRYLQRQHQLDLOXUHVVXUVH LOOXVWUDWVWKH
 RI JHWLQJ RQH RWZRRUHU IDROXUDDOXHVVRIHWEQGRHSHQGH
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 ZLWK D OHYHO RI WFRPHZHQWHIRXUVRURXVCRHSHQGHQW
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