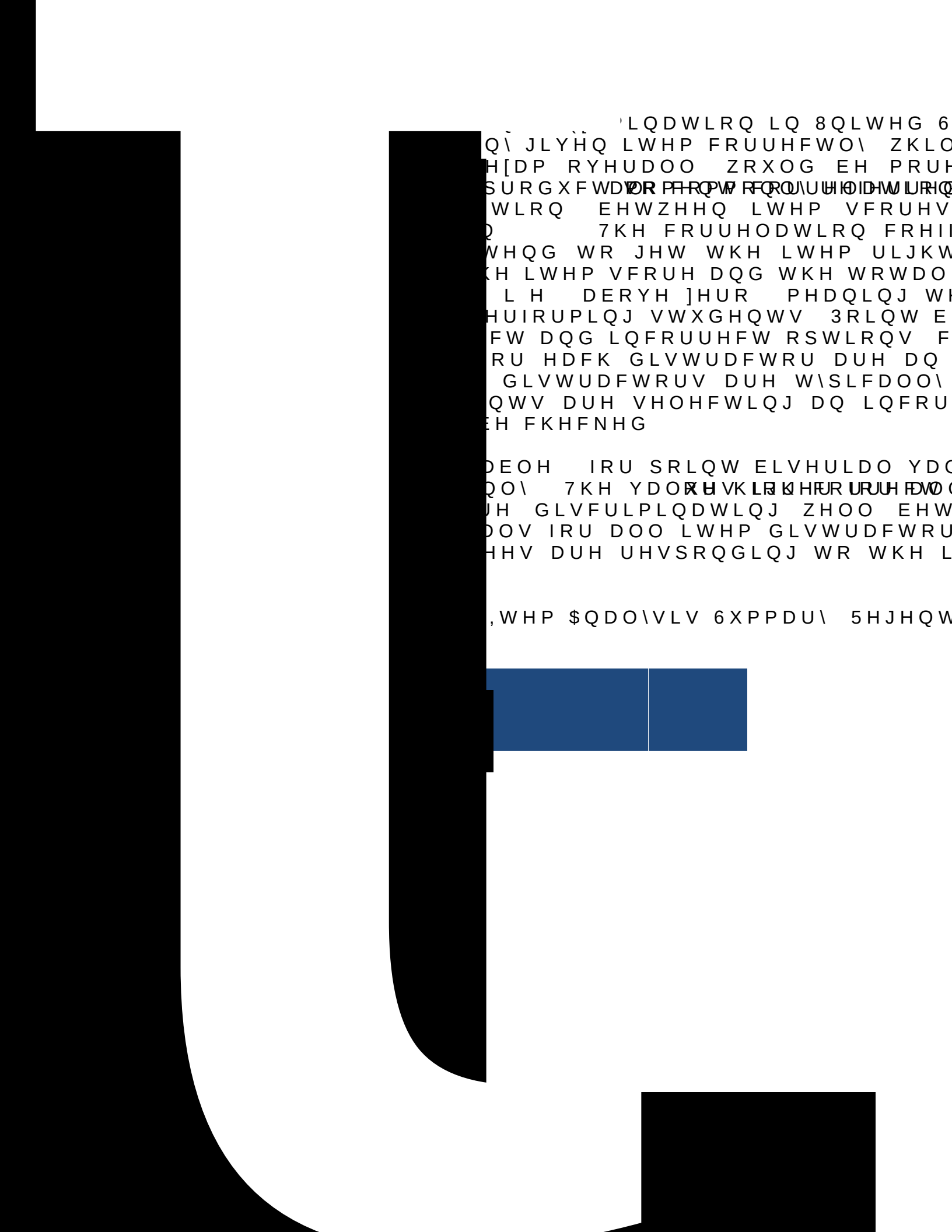

7DEOH VFULSWLYH 6WDWLVWLFV 3DQHO %LRORJLFDO &KHPLVWU\ 5HJHQW
([DPLQDWLRQ 8QLW 6WDWHQG +RVSLWDO

VWDQGDUG 5DVFK PRGHO DQG WKH VLQJOH VWHS GLIILFXOW
5DVFK PRGHO SUHGLFWV WKH HVWLPDWHG RYHUDOO WUDYHO GLVWDQFH

$$P_{ni}(X) = \frac{H(S_n, D_{ij})}{H(S_n, D_{ij})}$$

7KH 5DVFK PRGHO SODFHV ERWK SHUIRUPDQFH DQG LWHP
RGGV RU ORJLWV RQ WKH VDPH FRQWLQXXP :KHQ WKH PR
PRGHO SURYLGHV HVWLPDWHV RI H[DPLQHH SHUIRUPDQFH D
LQYDULDQW DFURVV UDQGRP VDPSOHV RI WKH VDPH H[DPLQH

62)7:$5($1' (67,0$7,21 $/*25,7+0

,WHP FDOLEUDWLRQ ZDV KHOG LQ 6HSWHPEHU RI WKH SURJUDP DQG
/LQDFUH ZKLFK HPSOR\V QRQGLPHQVLRQDO PDWKHPDWLFV WR HVW
-0/(

&+5&7(5,67,&6 2)&7+(7(67,1* 32$7,21

7KH GDWD DQDO\VHV UHSRUWHG KHUH DUH EDVHG RQ D
([DPLQDWLRQ LQ 8QLWHG 6WDWHV DGPLQLVWHUHG LQ WKH IDO
FKDUDFWHULVWLFV RI WKLV SRSXODWLRQ DUH SURYLGHG

,7(0 ',))),&8/7<3'(173(5)250$1&(0$36

7KH GLVWULEXWLRQ RI LWHP ORJLWV LWHP GLIILFXOW
SHUIRUPDQFH DUH VKRZQ RQ WKH VDPH VFDOH 7KLV JUDSKLF LOOXVWUDWHV WKH ORFDWLRQ RI VWXGHQW
VFDOH ZLWK WKHLU UHVSHFWLYH GLVWULEXWLRQV DQG
GRWWHG OLQHV 7KH ILJXUH VKRZV PRUH GLIILFXOW LWHPV
WRS DQG ORZHU SHUIRUPDQFH DQG HDVLHU LWHPV DW WKH

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

) L J X U H W X G H Q W 3 H U I R U P H D Q F H W V D [D P L88îÂ 88#Ž P

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

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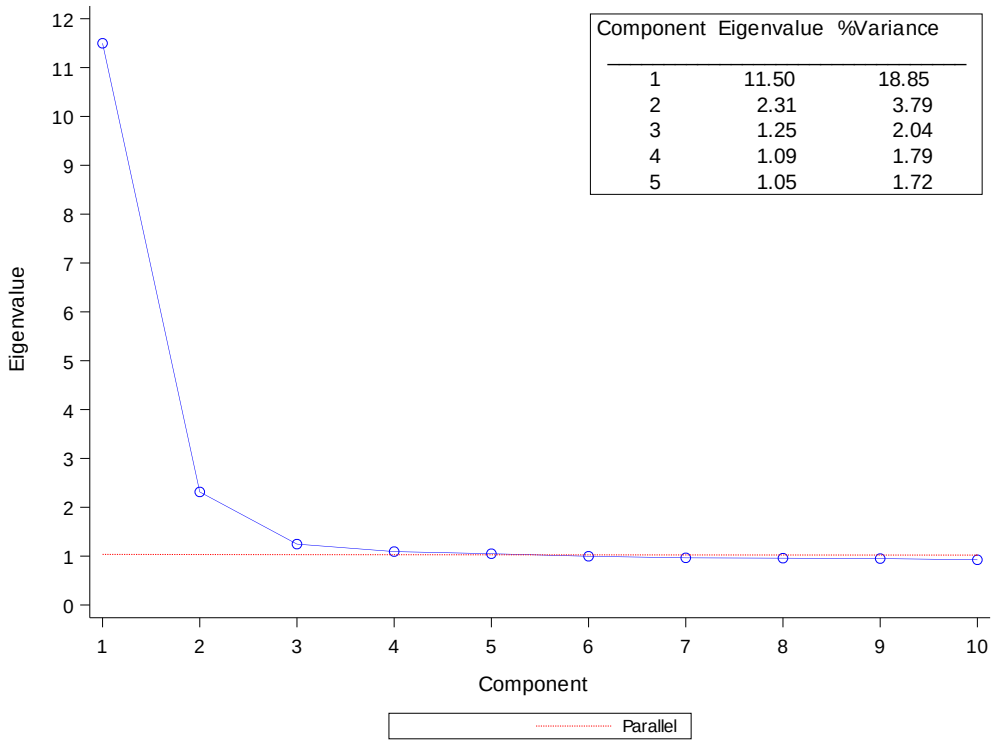

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3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

,WHPV IRU WKH ([DPLQDWLRQ +LVWRU\ RI WHVWHG LQ DQG

6&$/,1* 2) 237,21$/ 7(67)250

2SHUDWLRQDO WHVW LWHPV ZHUH VHOHFWHG EDVHG RQ F
VWDWLVWLFDO VHTXHQWLDO DQDO\VLV RI HDFK RSHUDWLRQDO WHV
GHWHUPLQHG E\ FRQWHQW H[SHUWV ZRUNLQJ IURP WKH OHD
<RUN 6WDWH (GXFDWLRQ 'HSDUWPHQW DQG H[SOLFDWHG LQ
DQG 5DVFKRWLVWLFV ZHUH XVHG WR DVVHVV LWHP TXDOLW
GLIILFXOW\ DQG RWKHU FKDUDFWHULVWLFV ¶ DELOLWL
$SSHQGL[$ DQDO\VLV WKH RSHUDWLRQDO W+DVN DQDO\VLV RI WKH S
DGPLQLVWUDWLRQV 1RWH WKDW WHVW GDWD SUHVHQWHG RQ
RQ WKH ILHOG WHVW GDWD

$OO 5HJHQWV H[DPLQDWLRQ GDWD DUH DQDO\]HG DFFRUGLQJ WKDW WKH SDUDP
WKH UHODWLRQVKLS EHWZHHQ HDFK WULPZDWH DQG VFRUH WR WKH
a''ëÂ /%,$ Ff€

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

WK PDDHO‘PH •Hcà0O @UA ‘VW H Op0DLRO Õ H• F`@

7KH PLQLPXP]HUR DQG PD[LPXP SRVVLEOH UDZ VFRUHV
DQG UHVSHFWLYHO\ WKDW WKHUH DUH UDZ VFRUH

&KDSWHU 5HOLDELOLW\ 6WDQGDUG

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

VWDQGDUG GHYLDWLRQ LQWR DFFRXQWSR&LRQQW LWGHHVWWZKRXW G
GLIIHUHQPW6(0 RI RQSDLQW WHVW

7UDGLWLRQDO 6WDQGDUG&RUUHODWLRQ0HWKRGRORJ\ 7KH 6(0 LV DQ LQGH[RI WKH UDQGRP YDULDELOLW\ LQ WHV
ZKLFK LV ZK\ LW KDV VXFK JUHDW XWLOLW\ IRU WHVW VFRU
WKH SUHFLVLRQ RI LQGLYLGXDO VFRUHV 7KH 6(0 LV DOVR
DURXQG REVHUYHG VFRUHV WKURXJK FRQVWUXFWLRQ RI DQ
WR DV FRQILGHQFH LQWHUYDOV WKHVH EDQGV DUH;FRQVW
DQG DGGLQJ6XEWUDFWLQJ DFFRUGLQJ RI WKH 6(0 $V D
JLYHQ WUXH VFRUH ZLOO KDYH REVHUYHG6(0 GDWD RXWKWLZRKDWI
WLP)HRU 6(0 FRQILGHQFH LQWHUYDOV WKLV LQFUHDVHV WR D

7KH&RHIILFLHQWDO SDSSKDFLDWHG(JHQWV ([DPLQDWLRQ LQ 8
+LVWRUDQG *RYHUDQSHQWGLG7EL QH

7DEO5HHOLDELOLWLHV DQG 6WDQGDUG5H(UURUV (RI0HDVXUHPH
8QLWHG 6WDWHV*RYHUQPHQW

Subject	Coefficient Alpha	SEM

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

7KH UHODWLRQVKLSEHWZHHQFDLVH QVRFVRUHH[SUHVVLEOH LQ
PDWKHPDWLFDO IRUPDEHEHQXGHRGLHWWUKHHWSKRORJ\RPLDO UHODWL
WKH UDZ DQG VFDOHGVKHVFORRUQHOLQHSUEHWZEHWQRWKHLH[SHFWHG
VFRUHV ,Q DGGLWLRQ HDXDWWKHG IURP \HDU WR \HDU WKH U
UDZ DQG VFDOH VFRUHV PRYHVWDKZGHGIUHRP SWRKOHQRUPLJLQDUHO
RQH WKDW LV DOVR QR OHVVHQFEOHHPSDWKVHVLEWHFDQ IRUP ,Q
VLPSOH PDWKHPDWLFDO UHDQGWLWRKQHVKLSEHWZHHQ WKH
DYDLODEOH MRFURUHDFYLD 5DVFK ,57 FDQQRW EH FRQYHUWHG
PHWULF

7KH XVH RI 5DVFKQ5H7DWQG VHTXDWH WKH 5KRZQWDUN[HDLW G
SRVVLEOH WR FDEXVLQWHW&6(SURFHGXUHV GHVFULEHG E\ .R
IRU GLFKRWRPRXVO\ VFRUHG LWHPV DQG H[WHQGHG E\
SRO\WRPRXVOHPWFR)URHUG WLHWV 5HXJHKQWV (WKHLQDWLRQ LQ 8
+LVWRQG *RYHUQPHQWKDYWRQHRQHODWLRQVKLS DEHGZZHHQ
VFRUHV WKH &6(0 IRU HDFK DFKLHYDEOH VFDOH VFRUH FD
PXOWLQRPLDO GLVWULEXWLRQ WR UHSUHVHQW WKH FRQGLW

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

MARGINAL	· í	· î	1

) L J X U H V H X G R

7DEOH

SURFHHGLQJ SODFH XOWLPDWHQHVV RRWDDJHWVFXRGQHVLWWQEQFW
H[HDLQHH VFRSHRYDGGQJHWKHYDFOLGLW\ RI WKHLU LQWHUSU

6SHFLILFKOWPWHYLHZSULFXRXUPDMRU LWWRXFKDUF
1HZ <RUN 6WDWH (GXFDWRQ 'HSU LQ GHYLSQJ TXDOLW\

DQJXDJHUDSKLFDO DSSURSULDWHQHVV
VHQVLWLWLVW\
ILGHOLWRXUPWRQGUGV
FRQIRUPLWH[SHFWDWLRQVWKHFLILF LWDEHUWPSWV

(DFK VHFRWLRQH FLQFOXGHV SHUWLQHQW TXHVWLRQV WKDV
ZKHWKHU RU QRW DQ LWHP LVWRKLQXWKHLHQWWTXDZORLWDWHJ
DQJXDSSURSULDWHQHVVG WR KHOS HQVXUH WKDW VWXGHQW
HDFK TXHVWLRQ DQG WKDW WKH ODQJXDJH LQHFWKE TXHVWL
DELOLW\ WR SHUIRUP6WKHODQXLWLDUHDWLNLD DUH XVHG W
ZKHWKHU TXHVWLRQV DRUHQXQLEYLHVEGG QRRQW GLVDGYDQWDJ
VXEJURXS V

7KH WKLUG FDWHJRRDF$G FDW7€FWpÄGV0$D•QUO\

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

9PBB2/0dd@ GPFULH0PRp FDW7³ ó–DR EP

REMHFWLYH RI MLQHGLQJ³UHDWRUWV LV WR FUHDWH D WUDLQL
H[HFXWLYH RQ WKH IURP ZKLFK DUH XVHG WR JHQHUDWH LPSRU
WKH LWHUDWLQJ SURFHVV WR EDODQFH DFFXUDF\ DQG VSHHG IRU
JXLGHV DQG VFRULQJ DQFLOODULHV WR EH XVHG GXULQJ RS

7R UHYLHZ DQG VHOHFW WKHVH DQVZHUV SDVVHV 1<6(' 6HQ
WKH UDQJLQJ VHVVLRQ ILQG WKHVH SURFHVVHV RI HGXFDW
VHW RI VWXGHQW SDSHUV WR G\QDPLFDOO\ PHDVXUH PHPEHUV ID
WKHPVHOYHV ZLWK HDFK LWHP W\SH DQG VFRUH D QXPEHU
HDFK RI WKH GLIIHUHQW WKHFRLQHG SURFHVVHV DQG VWDWH
UHYLHZV DQG GLVFXVVHV WKHLU UHVXOWV DQG GHWHUPL
UHVSRQVHV 'XULQJ WKLV SURFHVV DW\SLFDO UHVSRQVHV D
XVH LQ WUDLQLQJ RU UDQJ 7KLV HQDEOHV UHVXOWV DUH WKHQ XV
PDWHULDOV IRU WKH YHQGRU¶V VFRUHUV ZKR WKHQ VFRU
FRQVWUXFWSHRQVH LWHPV 7KH ILQDO PRGHO GHPRQVWUDWHV
5HJHQW([DPLQDWLRQ LQ 8QLWHG6WDWHV 3DWHQW DWH D
KWWS ZZZ S Q\VHG JRY DVVHVVPHQW VDPSOHUV

'XULQJ WKH QDQJH DQG ILHOG WHVW VFRULQJ SDUWLFLSDQ
DQG FRQWURO IRU VRXUFHV RI YDULDWLRQ LQ VFRULQJ
FRQVWUXFWSHRQVH VFRUHV LV XQLQWHQGHG UDWHU ELDV DV
UHVSRQVHV %HFDXVH WKH UDWHU LV RIWHQ XQDZDUH RI
PRVW FKDOOHQJLQJ VRXUFH RI YDULDWLRQ LQ VFRULQJ WR
DSSHDU DV VHYHULW\ RU OHQLHQF\ LQ DSSO\LQJ HQRUPRXV
VXFK DV WKH ZRUGLQHVV RI JRRG RU SRRU SHUIRUPDQFH RQ
UXEULF HQFRXUDJHV LQDFFXUDWH VFRULQJ RI RWKHU HOHP
HIIHFWLYHO\ FRQWURROHG E\ WUDLQLQJ SUDFWLFHV ZLWK D

7KH WUDLQLQJ SURFHGXUH DOVR GRFXPHQWV EHJLQV ZLWK
GLVFXVVLRQ RI DFWXDO VWXGHQW SRZRUN WR HQVXUH XQGHU
XQGHUVWDQG WKH UDQJH DQG FKDUDFWHULVWLFV W\SLFDO
RI PLVWDNHV VWXGHQWV FRPPRQO\ PDNH 7KLV LQIRUPDWLRQ LV
FRQVLVWHQWO\ DSSO\ NH\ HOHPHQWV RI WKH VFRULQJ U
UHVSRQVHV

5DWHUV WKHQ UHFHLYH WUDLQLQJ FRQVLVWLQJ RI
ILHOG WHVWV DQG JH DOORZHG WR SUDFWLFH VFRULQJ SULRU WR
WKH VFRULQJ SURFHVV WKHUH DUH LPSRUWDQW SURFHGXU
PLVDSSOLFDWLRQ RI VFRULQJ UXEULFV LQFRUUHFW VFRULQJ
FRUUHFWLRQ GR QRW RFFXU GXULQJ WKH WUDLQLQJ SHULRG
$FFRUGLQJO\ D VFRULQJ OHDG PD\ EH DVVLJQHG WR UHYLH
DVVLJQHG VWDII DJDLQVW WKH EHKDLRUDO DQFKRUV DQG VXOWDWL
VFRULQJ SURFHVV

$WWHQWLRQ WR WKH UXEULF GHVLJQ DOVR IXQGDPHQWDO
UHVSRQVH SURFHVVHV 7KH UXEULF VSHFLILHV ZKDW WKH H[
OHDUQHUV VKRXOG RQ WKH TXHVWLRQ DVNHG 7KH PRUH H[SOLFLW
FOHDU WKH UHVSRQVH H[SHFWDWLRQV DUH IRU H[DPLQHH

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

,57 0RGHO)LW

RI 1HZ <RUN XQLYHUVLWLHV DQG FROOHJHV ILQGV WKDW

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

5HIHUHQFHV

$PHULFDQ (GXFDWLRQDO 5HVHDUFK $VVRFLDWLRQ $PHUL
1DWLRQDO &RXQFLO RQ 0HDVXUHPHQW LQ (GXFDWLRQ &RVW RI (GXFDWLRQDO
SV\FKRORJLFDO DVVHVVPHQW '& $PHULFDQ (GXFDWLRQDO 5H

%DUNDRKXLOHG (IIHFWV RI PDUNLQJ PHWKRG DQG UDWHU H
VFRUHV DQG UDWHU $VVHVVRUV DQG (GXFDWLRQ 3ULQFLSO

&RQJGRQ 3 - 0F4XHHQ 7KH VWDELOLW\ RI UDWHU DOHHY
DVVHVVPHQW -RXUQDO RI (GXFDWLRQDO 0HDVXUHPHQW

&RRN ' $ %HFNPDQ 'RHV VFDOH OHQJWK PDWWHU" $ F
YHUVXV SRLQW UDWLQJ &(;DGHYDQFHV LQ +HDOWK 6FLHQFHV
±

&URQEDFK / - /LQ 5 / %UHQQDQ 5 7 *HQHUDOL]DE(L
)H“

&RS\ULJKW ‰ 1DWLRQDO Da& H“R OE@2• 0 / 0Ð ð /7I 5 / %

+DULN 3 &ODXVHU % (*UDERYVN\ , 1XQJHVWHU 5 -
6SULQJ H[DPLQDWLRQ RI UDWHU LQWHUFODVV UHOLDELOLW\ WKHRU\ JUH
-RXUQDO RI (GXFDWLRQDO 0HDVXUHPHQW

+DUYLOO / 0 6WDQGDUG(UURU RI0HDVXUHPHQW DQG3HUVRQDO
3UDFWLFHV±

+RUQ- / $ UDWLRQDOH DQG WHVW IRU WKH DQDO\VLV
3V\FKRPHWULN±D

+R\W : 7 .HUQV 0DJQLWXGH DQG PRGHUDWRUV RI ELDV
PHWDDQDO\VLV3V\FKRORJLFDO 0HWKRGV

+X\QK + 6WDWLVWLFDO FRQVLGHUDWLRQV LQ6HFRQGDU\DQDO\VHV\

:DQJ ; 0 :RQJ .) (.Z<RQJ -7K<H UROHV RI UDWHU JRD
SHUIRUPDQFH OHYHOV LQ WKH GLVWR-URWXLRQQDORIRISHUSRO
3V\FKRORJ\ ±

:HLJOH 6 & 8VLQJ)$&(76 WR PRGHO UD/WHUXWJHLVWDQWL7HLQJ
±

: HLQURWW / -RQ2HYHU%W YHUVHV FRYHUW DVVHVV&KLQWG RI
'HYHORSPHQW±

:RHKU ' - +XIIFXWW5DS$WH,U WUDLQLQJ IRU SHUIRUPDQFH D
UHYL-HZXUQDO RI 2FFX&S2DWLRQDO 3V\FKRORJ\

:ROIH (: *LWRPHU7KH+LQIOXHQFH RI FKDQJHV LQ DVVHV
SV\FKRPHWULF TXD3OLW\ RI HRWRQ1HV(GXFDWLRQDO 7HVWLQJ

7DEOH7$HVW 0RS -DQXDU\ $GPLQLVWUDWLRQ

7DEOH7$HVW 0RS -XQH $GPLQLVWUDWLRQ

7DEOH69%RUH 7DEOH IRU -DQXDU\ $GPLQLVWUDWLRQ

Raw Score	Ability	Scale Score
0	> -5481	0.000
1	> -3288	0.845
2	> -1613	1.754
3	> -0186	2.575
4	> +0876	3.566
5	> +1631	4.464
6	> +2427	5.452
7	> +3251	6.435
8	> +4095	7.424
9	> +4956	8.499
10	> +5828	9.586
11	> +7111	10.672
12	> +8601	11.849
13	> +9499	12.945
14	> +1.4025	14.132
15	> +1.5310	15.418
16	> +1.6223	16.625
17	> +1.7139	17.925
18	> +1.8059	19.228
19	> +1.9821	20.548
20	> +2.0907	21.861
21	> +2.2834	23.170
22	> +2.4764	24.595
23	> +2.6956	26.028
24	> +2.8628	27.351
25	> +3.0563	28.785
26	> +3.4991	30.242

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

&+(&./,67 2) 7(67 &216758&7,21 35,1&,3/(6
0XOWLSOH &KRLFH ,WHPV

	<(6	12
,V WKH LWHP VLJQLILFDQW"		
'RHV WKH LWHP KDYH FXUULFXODU YDOLGLW		
,V WKH LWHP SUHVHQWHG LQ FOHDU DQ YRFDEXODU\ NHSW DV VLPSOH DV SRVV		
'RHV WKH LWHP KDYH RQH DQG RQO\ RQ		
'RHV WKH LWHP VWDWH RQH FRQFHSW RU VWHP" 6HH +HOSIXO +LQW EHORZ		
'RHV WKH VWHP LQFOXGH DQ\ H[WUDQH GUHVVLQJ´ "		

$SSHQGL[' 7DEOHV DQG)LJXUHV IRU $X $GPLQLVWUDWLRQ

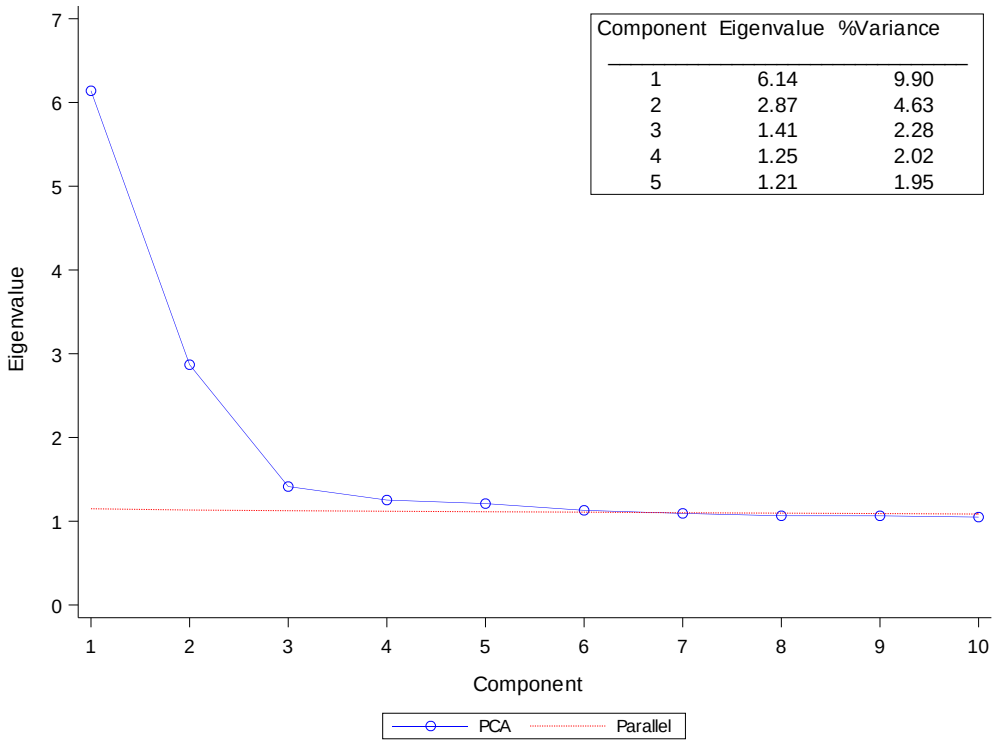
7DEOH0XOWL&RKRUH ,WHP $QDO\VLVJHQHUDWHGXVLQJ8QLYDULDQW$QDO LQ 6WDWLVWLFDO3DFNDJH *RYHUQPHQW

Item	Number of Students	-Value					

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ

7 D E O H & R Q V W U X F W H G U H V S R Q V H , W H P $ Q D O \ V H V J H Q H U D W L R Q
8 Q L W H G 6 W D W H V * R Y H U Q P H Q W

Item	Min. score	Max. score	Number of Students	Mean	SD	-Value	Point-Biserial
THM	0	5	12,496	1.33	1.06	0.27	0.66
1	0	1	12,496	0.92	0.27	0.92	0.25
2	0	1	12,496	0.94	0.23	0.94	0.23
3a	0	1	12,496	0.92	0.28	0.92	0.28
3b	0	1	12,496	0.83	0.37	0.83	0.31
4	0	1	12,496	0.94	0.24	0.94	0.26
5	0	2	12,496	1.66	0.63	0.83	0.35
6	0	2	12,496	1.77	0.54	0.89	0.34
7	0	2	12,496	1.89	0.39	0.94	0.31
8	0	2	12,496	1.83	0.50	0.92	0.28
9	0	1	12,496	0.78	0.41	0.78	0.34
DBQ	0	5	12,496	2.18	0.94	0.44	0.62

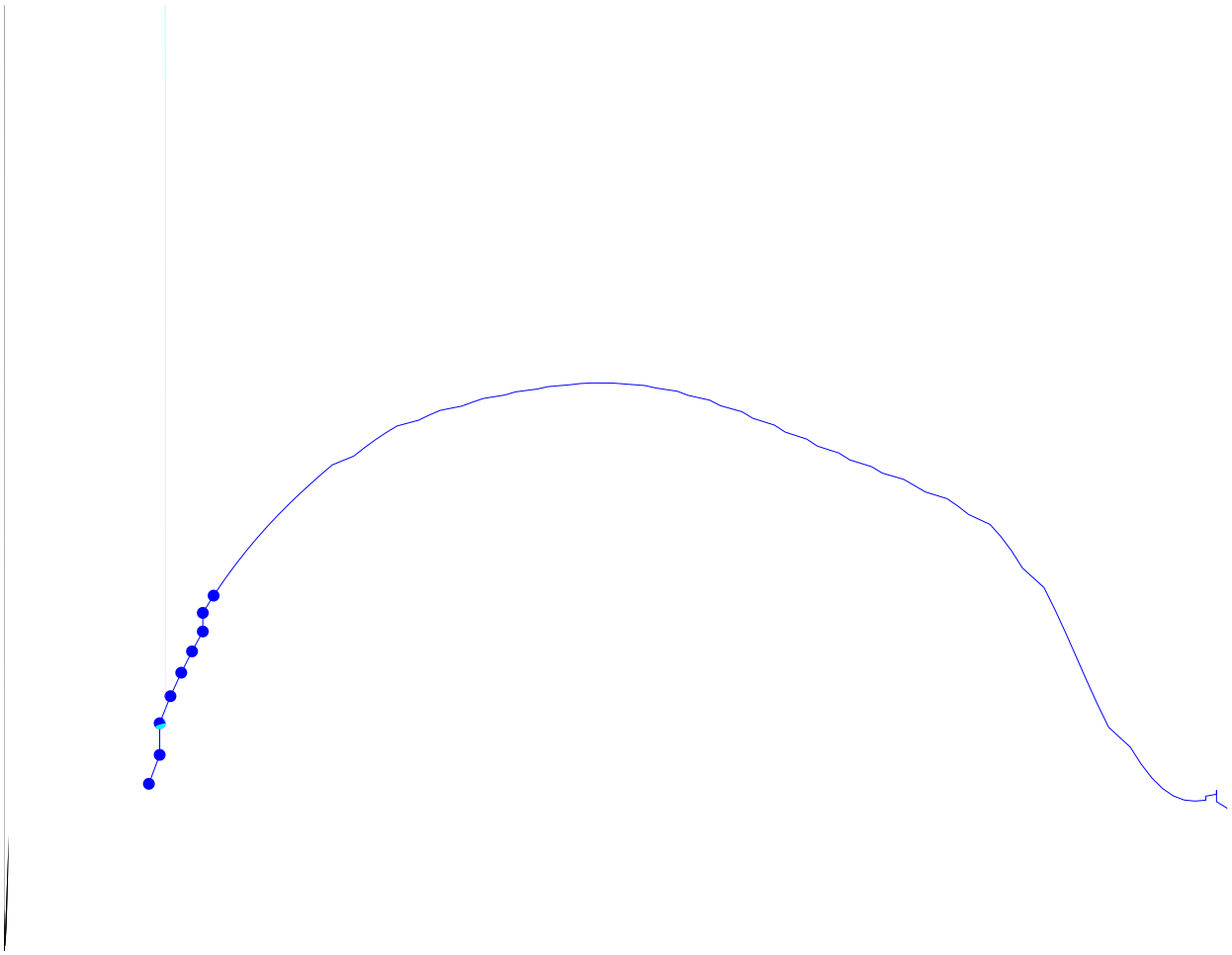


)LJXUH6FUHH 3ORW RI WKH (LJHQYDOXHV *HQHUDWHG E\ 3HDUVRQ

7DEOH6XPPDU\ RI ,WHP 5HVLGXDO &RUUHODWLRQV LQ 6WDWLVWLFV *HQHUDWHG E\

Statistic Type	Value
N	1891
Mean	-0.01
SD	0.03
Minimum	-0.11
P_{10}	-0.05
P_{25}	-0.03
P_{50}	-0.02
P_{75}	0.00
P_{90}	0.02
Maximum	0.25
>|0.20|	3

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ



)LJXUH&RQGLWLRQDO 6WDQGDUGL]HG(WUDQVIRUPDWLRQ6WDWHV
+LVWRULFDO *RYHUQPHQW

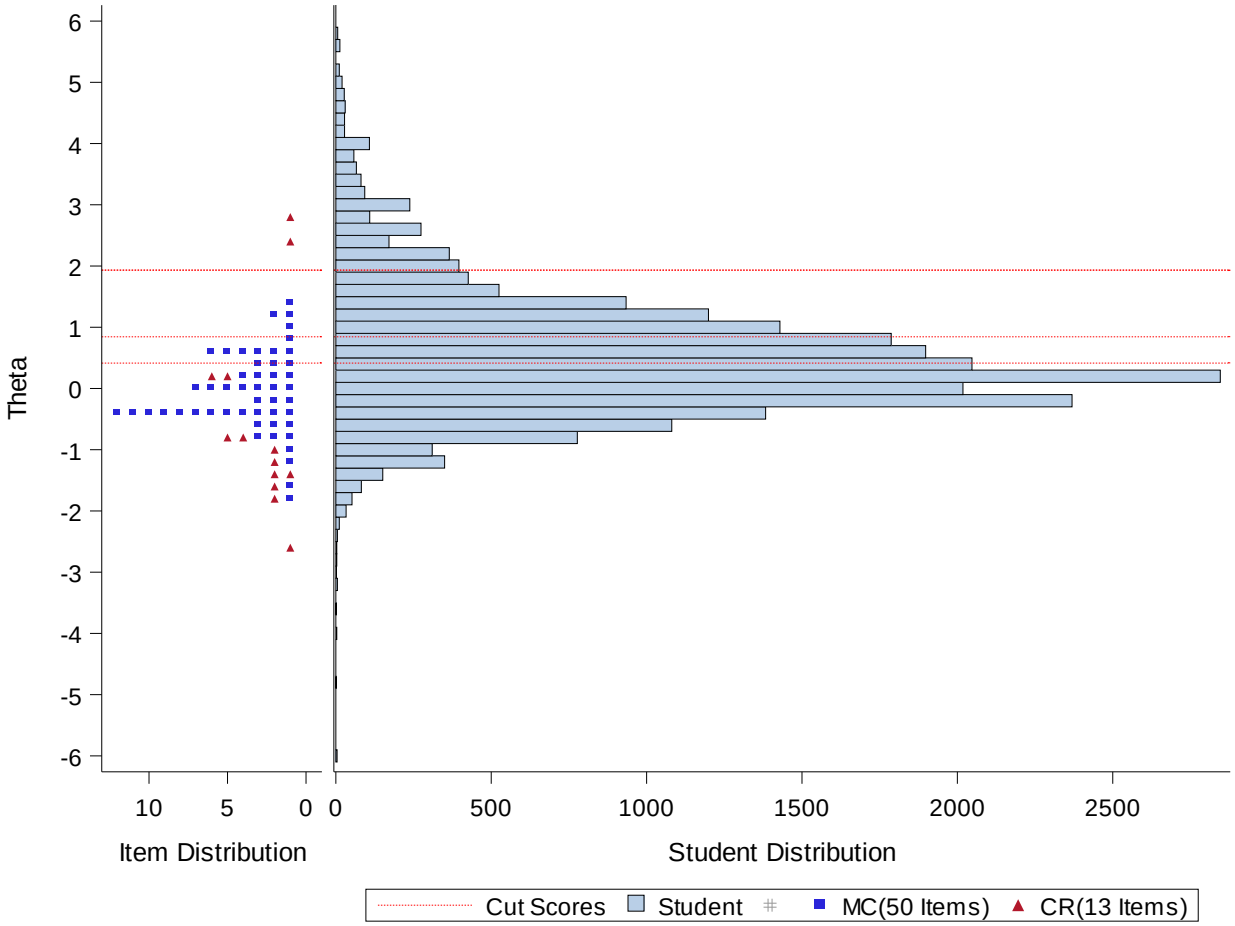
7DEOH*URXS 0HDQJHQWV ([DPLQDWLRQ 3DWWHUQ 6WDWHQG *RYHUQPHQW

Demographics	Number	Mean Scale Score	SD Scale Score
All Students*	12,496	59.50	15.65
Ethnicity			
American Indian/Alaska Native	124	59.15	13.78
Asian/Native Hawaiian/Other Pacific Islander	768	58.95	17.38
Black/African American	4,362	57.95	14.72
Hispanic/Latino	4,284	58.56	15.11
Multiracial	96	61.17	16.76
White	2,801	63.72	16.60
EEEEEEEE			

Item	Number of Students	-Value	SD	Point-Biserial	Point-Biserial Distractor 1	Point-Biserial Distractor 2	Point-

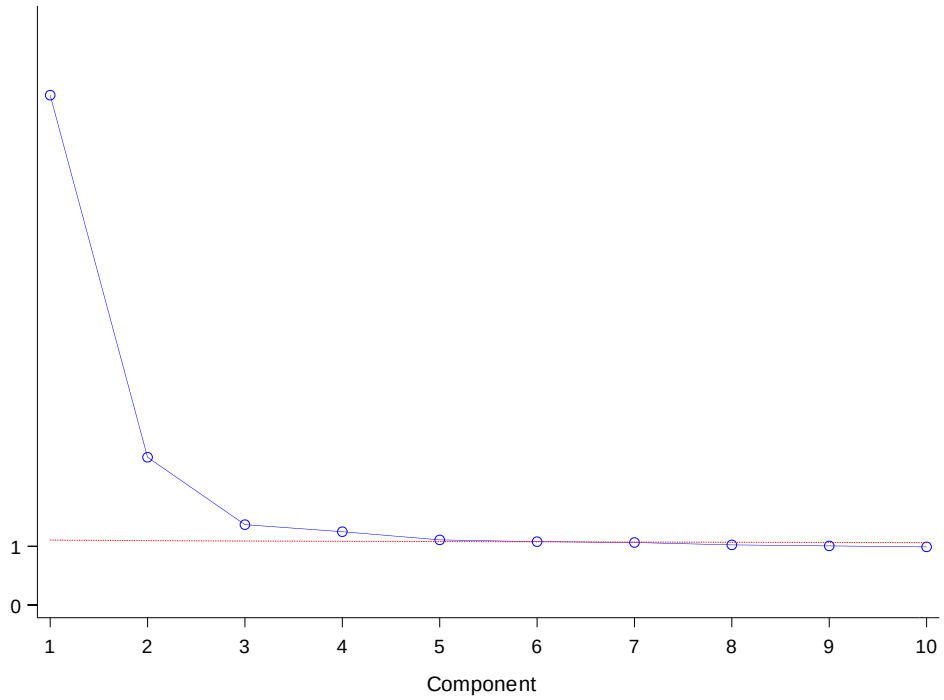
7DEOH'HVFULSWLYH 6WDWLVWLFVIRU3RVW&DOLEUDWLRQ &RUUHODWLRQ 5
([DPLQDWLRQ8QLWHG 6WDWHVG+LVWRULQQP HQW

Statistics	N	Mean	Min	Q1	Median	Q3	Max
p-value	63	0.58	0.21	0.47	0.57	0.71	0.93
Point-Biserial	63	0.35	0.19	0.30	0.34	0.40	0.69



)LJXUH6WXGHQW 3HUIRUPDQFH:DSDPL&RXQW\6FKRROV\ DQG *RYHUQPHQW

3UHSDUHG IRU 1<6(' E\ 3HDUVRQ



)LJXUH6FUHH 3ORWQWV ([DPLQDWLRQ *RYHUQPHQW

7DEOH6XPPDU\ RI ,WHP 5HVLGXDO&RUUHODWLRQV [DPLQDWLRQ LQ 6WDWHWLWLRQ *RYHUQPHQW

Statistic Type	Value
N	1953
Mean	>.001
SD	0.03
Minimum	>.112
P_{10}	>.005
P_{25}	>.003
P_{50}	>.002
P_{75}	0.00
P_{90}	0.02
Maximum	0.25
>|0.20|	1

7 D E (Q H 6 X P P D U \ , 1 R) I, 7 0 H D Q 6 T X D U H 6 W H D J W H L Q W W L F [M D P L O 3 D Q W W R G L Q
6 W D W H W L W W R Q G * R Y H U Q P H Q W

	INFIT Mean Square					
	N	Mean	SD	Min	Max	[0.7, 1.3]
United States History and Government	63	1	0.07	0.89	1.17	[63/63]

7DEOH*URXS 0HPEHUVKLS ([DPLQDWLRQ 6WDWHPHQW
*RYHUQPHQW