



Gender and the time cost of peer review

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In this paper, we investigate one factor that can directly contribute to—as well as indirectly shed light on the other causes of—the gender gap in academic publishing: length of peer review. Using detailed administrative data from an economics field journal, we find that, conditional on manuscript quality, referees spend longer reviewing female-authored papers, are slower to recommend accepting them, manuscripts disappear faster, and referees review more papers. This pattern suggests novice referees implicitly statistically discriminate against female authors, but are less likely to do so as their information and confidence in the peer review process improves. More generally, they also suggest that women may be particularly disadvantaged when evaluators are less familiar with the objectives and parameters of an assessment framework.

A11, D8, J16, J24, J7

Gender Inequality, Statistical Discrimination, Research Productivity, Peer Review

$$:2M/2^{\prime} \quad M/i?2 \quad iBK2 + Qb\uparrow Q7 \quad T22^{\prime} \quad ^{\prime}2pE$$

$$.B \quad M2 \quad H2t^p M/2^{\prime}$$

$$R \quad A M i \backslash Q / m + i B Q M$$

PM p2` ;2- K2M BM + /2KB Tm#HBb? KQ`2 T2IT 2KbRM ?QK2M 2Kq2BM b H ` ;2
7i2` +QMi`QH HBM; 7Q` Q#b2` pi# H2KRXiQ i bHb Q 2 KQ` ;2b bm` T` BbBM; Hv 2` H

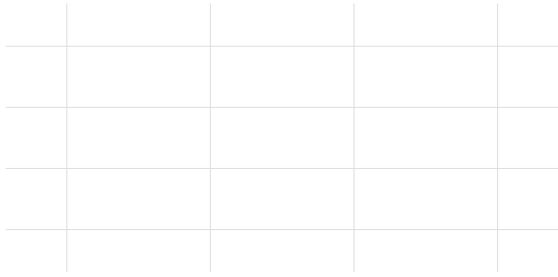
Pry R N

TQQ`Hv BM7Q`K2/ `272`22bc r?2M `2pB2r2/ #v r2HH@BM7Q`K2/ `272`22b-`
TQbbB#Hv `2p2`b2X h?Bb T ii2`M bm;;2bib i? i MQpB+2 `272`22b BMBiB H
72K H2 mi?Q`b- #mi b i?2v ; BM 2tT2`B2M+2- i?2B` #BHBiv iQ B/2MiB7v
T T2`b +QMp2`;2b- bQ ; Tb BM `2pB2rBM; iBK2- ++2Ti M+2 `i2b M/`QMm/
`2K BMB M BKT2`72+iT`Qtv 7Q`2zQ`i- Bib bBKBH `/2+HBM2 M2p2`i?2H2bb
r`Bi2`2TQ`ibi? i 72K H2 mi?Q`b `22bT2+B HHv[mB+FiQ`2bTQM/iQX JQ`
MQi #B b2/MK2M U+QM/BiBQM H QM b2H2+iBQM +`Bi2`B V- i?2Mi?2 2ti` iBK
iQ MQpB+2 `272`22b `2H iBp2 iQ 2tT2`i `272`22b +QKT `2/ iQ K2M r?B+? r2
/ vb +QMb2`p iBp2Hv TT`QtBK i2b i?2 +Qbi iQ rQK2M Q7 bi iBbiB+ H /Bb+`E
h?2b2 `2bmHib ?QH/ 7i2` ++QmMiBM; 7Q` `272`22 }t2/ 2z2+ib- bm;;2biBM;
i?2b K2272`22 `2pB2rb KQ`2 T T2`bX h?2v `2 HbQ `Q#mbi iQ CQM i`QH HBM
+Q/2b- BMBiBimiBQM H` MF- mi?Q`T`QKBM2M+2- MmK#2` Q7 +Q@ mi?Q`b
?Qr2p2`- i? i #2ii2` BM7Q`K iBQM + mb2b i?2; Tb iQ /2+HBM2 QMHv B7 TQQ
Q7 K Mmb+`BTib `2 +QKT `2/ iQ r2HH@BM7Q`K2/ #mi Qi?2`rBb2 B/2MiB+ H
K Mmb+`BTib- M bbmK TiBQM r2 2tTHQ`2 KQ`2 + `27mHHv BM TT2M/Bt
A/2MiB7vBM; i?2 TBpQi H`QH2 TH v2/ #v `272`22 2tT2`B2M+2 HbQ ?2HTb m
;2M/2`2/ +Qbi Q7 T22` `2pB2rX b `272`22b ; BM FMQRH2/;2 #M2i v?2 T`Q+
1+QM QK;2M/2` ; Tb BM `2pB2r H2M; i? /2+HBM2- bm;;2biBM; i? i 2/BiQ`b K v
BM Qmi+QK2b r?BH2 ?QH/BM; i?2 BM7Q`K iBp2M2bb Q7 i?2 `272`22BM; T`C
TQQH Q7 +QKT2i2Mi M/ 2tT2`B2M+2/ `272`22b M/ bbB;MBM; i?2K KQ`2 72H
h?Bb T T2` +QMi`B#mi2b iQ MmK2`Qmb bi` M/b Q7 i?2 HBi2` im`2X 6B`bi- r2
i? i/Bb+`BKBM iQ`v b2H2+iBQM T`Q+2/m`2b K v #2 H `;2Hv /`Bp2M #v 2p Hm
Q` H +F Q7 2tT2`B2M+2X AM T `iB+mHy`K"mQ`2F bM/iB2`b2biBM; iQ b?Qr i?
vQmM;2`- H2bb 2tT2`B2M+2/ HQ M Q{+2`b `2 KQ`2 HBF2Hv iQ `2[mB`2 ;m
+QKT `2/ iQ Qi?2`rBb2 B/2MiB+ H K H2 TTHB+ MibX qBi2BMHuxy r2M Mb272X
b?Qr i? i 2p Hm iQ`b `2 H2bb HBF2Hv iQ /Bb+`BKBM i2 ; BMBirQK2M bi?2
GBF2 "Q2i2Nixy R/N r2 Q#b2`p2 ?Qr Qmi+QK2b +? M;2 b i?2 b K2 2p Hm iQ`B
BM7Q`K iBQM- #mi bBKBH `iQ i?2 7Q`K2`- r2 7Q+mb QM 2p Hm iQ`bö FMQRH2
Q7 bb2bbK2Mi- ?QH/BM; i?2 BM7Q`K iBQM i?2v ? p2 #Qmi i?2 BM/BpB/m H
HHQrb mbiQ B/2MiB7v T bbBp2 M/ HBF2Hv KQ`2 72 bB#H2 K2 Mb Q7 mbB
i?2 M2; iBp2 +QMb2[m2M+2b Q7 #B b, `i?2`i? M;BpBM; `2pB2r2`b KQ`2 BM7
`2 2p Hm iBM;- bbB;M KQ`2 2tT2`B2M+2/ `2pB2r2`b iQ 2p Hm i2 rQK2MX
a2+QM/- r2 T`QpB/2 7m`i?2` 2pB/2M Ap#Fñc€• 2p Q7Q +QQ[m8 ° p€ •v BMf;29;2

72K H2@ivT2/ DQ# QTTQ`imMBiB22i-`HxKj2.2iH}M2QWUq2z/KiQ i?Bb`2b2`+?
#v bim/vBM; K#B;mBiv QM i?2 Qi?2`bB/2 Q7 i?2 bb2bbK2Mi T`Q+2bb M/}M
`2 HbQ KQ`2 +QKKQM r?2M 2p Hm iQ`b `2 H2bb 7 KBHB `rBi? i?2 Q#D2+iE
6BM HHv- Qm` 2pB/2M+2 bm;;2bib i? i T22` `2pB2r K v BKTQb2 ;`2 i2` +Qbi
2+QM QKBbibV r?2`2p2` i?2v bm#KBi- i?mb T`QpB/BM; 7m`i?2` 2pB/2M+2 i?
iQm;?2` bi M/ `/b i? M2K2M`U2i22Hxky>2M k2/Hk>2M;2H M/kjQXMJQbi
`2H2p Mi iQ Qm` rQ`fy-kv2M2H U? i 72K H2@ mi?Q`2/ T T2`b Tm#HBb?2/ BM
BMi2`2bi 2+QM QKB+b DQm`M Hb bT2M/ i?`22 iQ bBt KQMi?b HQM;2` mM/2
2[mBp H2Mi K H2@ mi?Q`2/ T T2`bX AM //BiBQM iQ }M/BM; bBKBH `iQT@H
DQm`M Hb- r2 #mBH/ QM i?Bb rQ`F #v mbBM; KQ`2 /2i BH2/ / i iQ BMp2biB;
/`BpBM; i?2b2 ; TbX
h?Bb T T2` T`Q+22/b BM i?2 7QH H/QrB+MB Q2b2i`x2 d2i+XBQ2B KBQ2M ;2M/2` ; Tb
BM iBK2 M/ H2M;i? Q7 T22` `2pB2rX a2+iBQM

q2 +QMbi`m+i2/ Qm` / i b2i BM i?`22 bi2TbX 6B`bi- r2 2ti` +i2/ i?2 7QHHQrB
B/ MmK#2`b- iBiH2b M/ +Q``2bTQM/BM; mi?Q`b 7Q` 7mHH@HM; ;i? - `2;mH
1+QM QKBM b b2T` i2Hv- UBBV i?2 M K2b M/ mMB[m2 B/ MmK#2`b 7Q` 2p2`
`2pB2r2/ T T2` i? i r b 2p2Mim HHv ++2Ti2/ 7Q` Tm#HB+ iBQMX

AM i?2 b2+QM/ bi2T- r2 +QHH2+i2/ Tm#HB+Hv p B X# 2#BQ17 Q+ B 2i M Q2M+QM @
iBQM +QmMibV M/ B/2MiB}2/ `272`22b M/ mi?Q`b rBi? KmHiBTH2 11J ++Qm



6B;m`2 R, amKK `v bi iBbiB+b 7Q` K MlM2+;B Li-bQTMQ#HB-b? 2/ BM

LQiX :` T? U V Bbi?2 irQ@v2 ` KQpBM; p2` ;2 Q7 i?2 T2`+2Mi ;2 Q7 T T2`b Tm#HBb?2/ M/ bmb
72K H2@ mi?Q`2/- r?2`2 672K H2@ mi?Q`2/6 `272`b iQ T T2`b rBi? 72K H2 +Q``2bTQM/BM;
irQ@v2 ` KQpBM; p2` ;2 Q7 i?2 iQi H MmK#2` Q7 K Mmb+`BTib Tm#HBb?2/ M/ bm#KBii2/ 2 +
THQi i?2 /Bbi`B#miBQM M/ irQ@v2 ` KQpBM; p2` ;2 Q7 iQi H MmK#2` Q7 `QmM/b- `2bT2+iBp2
/Bbi`B#miBQM M/ irQ@v2 ` KQpBM; p2` ;2 Q7 i?2 iQi H MmK#2` Q7 / vb ` K Mmb+`BTi bT2M/
:` T?b U:V M/ U>V b?Qri?2 /Bbi`B#miBQM M/ i?2 irQ@v2 ` KQpBM; p2` ;2 Q7 i?2 iQi H MmK#2`
rBi? mi?Q`b- `2bT2+iBp2HvX

T T2`b BM kyRy i? M i?2v /B/ BM kyy8- #mi #2ir22M kyRy M/ kyRN i?2 p2` ;2
`2H iBp2Hv ~ iX

6BM HHv- 72K H2 mi?Q`b bT2M/ KQ`2 iBK2`2pBbBM;H?QM/iQ2/Bi2i`B#?nQBQW
Q7 i?2 iQi H MmK#2` Q7 / vb mi?Q`b i F2 iQ`2pBb2 i?2B` K Mmb+`BTib #v ;2
RRR / vb`2pBbBM; i?2B` T T2`bc rQK2M bT2M/ R9y / vbX u2i i?2 +QK#BM iE
M/ 72K H2`2T`2b2Mi iBQM /Q2b MQi TT2` iQ /`Bp2 i?Bb T ii2`MX _2pBbB
BM i?2 H bi Ry R8 v2`bX AM kyy8- mi?Q`b iQQF- QM p2` ;2- RRk / vb iQ`2p
iQQF RRR / vb ~~u v x~~;m`2

AM TT2M~~X B~~r2 bmKK`Bb2 //BiBQM H / i QM 2/BiQ`B H /2+BbBQMb- T`QTQ`
p2` ;2 MmK#2` Q7 / vb bT2MirBi?`272`22b M/ mi?Q`b BM 2 +?`QmM/ Q7`;
Q7 K Mmb+`BTib`2 BKK2/B i2Hv ++2Ti2/ BM i?2 }`bi`QmM/c i?`22@[m`i2`
K F2 K DQ` M/ KBMQ``2pBbBQMb-`2bT2+iBp2HvX hBK2 bT2M/`2pB2rBM;
rBi?`QmM/- #mi 72K H2@ mi?Q`b?BT TQbBiBp2Hv +Q``2H i2b rBi? BiX h?Bb
i?2 2pB/2M+2 BM 6B;m`2

j :2M/2` ; Tb BM iBK2 M/ H2M;i? Q7 T22` `2pB2r

jXR *QM+2Tim H 7` K2rQ`F

AM i?Bb b2+iBQM- r2 /2}M2 7Qm` K2 bm`2b i? i + Tim`2 ;2M/2` /Bz2`2M+2b B
2p2Mim HHv ++2Ti2/ T T2`b, UBV i?2 ;2M/2` ; T BM i?2 KQmMi Q7 iBK2 `27
UBBV i?2 ;2M/2` ; T BM i?2 `QmM/@#v@`QmM/T`Q# #BHBiv Q7 ++2Ti M+2c
Q7 `2pB2rc M/ UBpVi?2 ;2M/2` ; T BM i?2 2zQ`i mi?Q`b 2tT2M/ `2pBbBM; i?
1[mViB 2pWkL2bmh2b i?2 ;2M/2` ; T BM i?2 KQmMi Q7 iBK2 `272`22b i F2 iQ 2p
/Q MQi`2D2+i Ubi ;2 Rk BM 6B;m`2

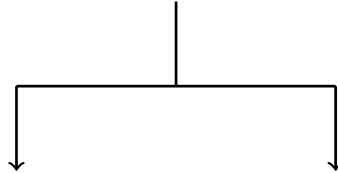
$$R = E \overset{h}{iBK_2} \overset{R}{iBK_2} jD_{j, \max t} = ++2; R_{j, t} 6 _2D; Q_{j, t} = Q_{j, m t} ; \quad URV$$

r?2`2 iB K B b i?2 H2M;i? Q7 iBbKT22M/222p2Hm iBM j,KB Mm QmDA T i Bb i?2
2/BiQ`öb /2+BbBQM i i?2 2M/naxtM2 j B b H`2QmB2Qm+2/ B K K 2M/QiBQM
r?2`22pB 22Mib p2öiQQQm/ HBiB2b`2Rj2p2Xi; KQp2Hiv- `B;Qm` M/ `2 / #BHBiv
l2m;f /2MQi2b K H2@ M/ 72K H2@ mi?Q`2/ T T2`b- `2bT2+iBp2HvX
1[m iB QWKL2 bm`2b i?2 ;2M/2` ; T BM m2R` QmM/@#Q-@8;Q-8MGE-T`QfA #B B Biv iB

Beginning of round t -----> End of round t

Stage 0. Author
Author drafts ($t = 0$)
or revises ($t > 0$)
manuscript j .

Stage 1. Referees
Referee i (re-)evaluates
 j with respect to qualities Q_{jt}
and recommends R



$6B; m^2 k, a^2[m^2 M + 2 Q^7 2 p^2 M i b / m^2 B M; ^2 p B b B Q M ^2 Q m M /$
 $L Q i \otimes _{Q m M \# / 2; B M b r B i ? i ? 2 m i ? Q ^2 B i t \neq 20} / ^7 i B M; U$

Pm`b2+QM/T`Q#H2K Bbi? i r2/Q M Qi FMQr i?2 +QKTQM2Mjt b BMj Hm/2/ BM i
MQ`/Q r2 FMQr?Qr2 +? Bbr2B;?i2/ BM`272`22bö M/2/BiQ`bö Qp2`HH/2+B
iQ UBKT2`72+iHvQjt`MQy BM`p`BQmb r vbX Pm`T`BK`v T`Qtv Bb +Bi iBQ
B7 +Bi iBQMb + Tim`2/}M H ++2Ti M+2 +`Bi2`B rBi? x2`Q MQM@+H bbB+
bm;;2bib i? i i?2v /Q M Qi +Bi iBQMb `2 M2Bi?2` `QmM/@bT2+B}+ MQ`K2 b
K v #2 BM~m2M+2/ #v T22` `2pB2r BM r vb i? X`6Q`2HK2HBi b m2K Q122`272`
rQ`F? `/2`iQ BKT`Qp2 rQK2Möb K Mmb+`BTibc i?2M +QM i`QH HBM; 7Q` +Bi
M/ max t X q2 i?2`27Q`2 HbQjt`MQy m QB M; `272`22bö M/2/BiQ`bö `QmM/bT2+
Bijt MDjt - 1[m iBQMQU MHvV- i?2 2/BiQ`öb /2+BbBQM Dp M i?2 m i2pBM u b `Qm
QM HvV- M/i?2 2/BiQ`öb /2+BbBQM B M i?2 QM QM Qm V/"2 + mb2 2 +? Bb mM/Qr
z2+i2/ #v i?2 b K2/Bb+`BKBM iBQM + Tim`2/ #v QMi`QH HBM; 7Q` i?2K K v +
mb iQ m M/2`@2biBK i2 i`m2;2M/2`; TbX L2p2`i?2H2bb- b HQM; b i H2 bi Q
Q7 rQK2M-i 22Q mH/ biBHH +QM b2`p R iBp2HvM/bTb Kxi2

$$iBK_{jt} = \alpha_0 + \alpha_1 72K_{jt}H_{22}Q_{jt} + \alpha_3 t + \alpha_4 I_{jt} + \alpha_j + \alpha_{jt};$$

r?2`2 i\$ B2 iBK2 bT2 Mi`2 pBb B BK MK QmMh`BT i?2 K tBKmK MmK#2` Q7 K Mmb+
T`2 pBQ mbHv Tm1#M2B bv?2# Q M#Q K Bmb mi? QX Q M B M 1[m B B Q M b M U/dU- r2
+Q Mi`QH 7Q` v2` Q7 bm#KBbbbBQM QjM-/ r2QmM2/2 i B i Q`Q 6v/2 Q B b B Q M b i i?2 2 M
T`2 pBQ mbDjQ m M / Ui?2 2 M / Q7 i?2 + mDit2 M i M Q m B M / i B Q M b X

j X j _ 2 b m H i b

```
h #H2/BbTH vb `2bmHib 7`QK PGa 2biBk8ViBQ`Q HQ7KMbm 6BRQMqKHyKM UjVV-
UjV U+QHmKM U9V U8VVX AM i?2 iQT T M2H- r2 T`Qtv 7Q`;
Q7 i?2 +Q``2bTQM/BM; mi?Q`c BM i?2 #QiiQK T M2H- r2 +QKT `2 bQHQ@7
K H2@ mi?Q`2/ T T2`bX _2bmHib BM #Qi? T M2Hb bm;;2bi i? i`272`22bi F2
72K H2@ mi?Q`2/ T T2`b- 72K H2@ mi?Q`2/ T T2`b ;Q i?`Qm;? KQ`2`QmM/
bT2M/ HQM;2``2pBbBM; i?2KX
```

6B`bi-`272`22b bT2M/- QM p2`;2-9 Ry / vb HQM;2``2pB2rBM;72K H2@ m
UkV Q7 **R**/Bb2H v`2bmHib 7`QK PGa 2biB**B**XBAQM+Q7H1f kM BQ MjUmr2bTB Q;tv 7Q`
+Bi iBQMbc Qm``2bmHib bm;;2bii? i`272`22bi F2 9X8 / vb HQM;2`iQ`2pB2

Rk ++Q`/BM; iQ T bi `2b2 `+? - K2M `2 /BbT`QTQ`iBQM i2Hv KQ`22HBHf3yRv iQ`/Bi22i?2B` QrM
K H2@ mi?Q`2/rQ2F UxkRQmRQ`F2M Hxky 62`#2N3eEQkyRWX 1+QMOKBbib #2HB2p2 72K H2@ mi
T T2`b `2 +Bi2/H2bb-?QH/BM; [m 2BixkyQxkbf WiUxkyky HbQ}M/i? i2/BiQ`b M/`272`22b;Bp
72K H2@ mi?Q`2/T T2`b HQR2` 2p Hm iBQMb- +QM/BiBQM H QM +Bi iBQMbX
Ri Hi?Qm;? 2 +? Q7i2b2 2t KTH2b +QmH/ BibH7 #2 Bmi2`T`2i2/ b` 7Q`K Q7/Bb+`BKBM iE
`2pB2r1M2`v 1+QMOKBb`Q`2 MQi+ TinR`2/ #v2Tj`QmM/b`A X

h #H2 R, :2M/2` ; Tb BM iBK2 M/ H2M, iM 2` 7VT22Q M2QKB + bi

	1[M X W	1[M X W	1[M X W	1[M X W		
	. vb bT2MirBi?`27E[222]Ti	LQX`QmM/bv	bT2MirBi?`mi?Q`b			
	URV	UkV	UjV	U9V	U8V	UeV
62K H2 +Q`2bTQM/BM; mi?Q`b						
72K H2	4:482 (1:647)	4:754 (1:677)	0:028 (0:014)	0:103 (0:046)	11:133 (5:216)	10:890 (5:377)
t U`QmM/V	15:893 (0:972)	12:608 (1:625)	0:363 (0:016)		41:755 (2:340)	28:627 (2:182)
+Bi iBQMb U bB4099V	5:243 (0:836)		0:002 (0:004)	0:011 (0:015)	11:604 (1:796)	
Rijt U`272`22öb`2+QKK2M/ iBQM V						
`2pBb2 UKBMQ`V		5:413 (1:798)				
`2pBb2 UK DQ`V		7:187 (2:280)				
Dit U2/BiQ`öb /2+BbBQM V						
`2pBb2 UK DQ`V		2:963 (3:215)				2:382 (7:482)
`2pBb2 UKBMQ`V		2:643 (1:986)				5:581 (4:495)
Ij UT`QKBM2M+2V					1:263 (0:367)	1:477 (0:278)
Djt 1 UK DQ`V						43:731 (4:204)
LQX Q#bX	d-y99	d-y99	d-9dj	k-j8N	j-3RN	j-3RN
R ²	yXy3j	yXydR	yXkd8	yXyj3	yXRR9	yXRje
"QmM/bW	(9Xk9- 9X93)	(9Xd8- 9Xd3)		(@yXy9- @yXyj)	(yXRY- yXRY)	(NX
J2 M /2TX p`X8jXk3y	8jXk3y	yXkdk	RXekk	dRXkyN	dRXkyN	
aQHQA@ mi?Q`2/ T T2`b						
72K H2	9:571 (3:975)	8:852 (4:104)	0:013 (0:035)	0:071 (0:122)	30:741 (17:150)	30:856 (17:670)
t U`QmM/V	12:250 (1:308)	8:661 (1:853)	0:329 (0:029)		34:898 (5:465)	27:559 (5:634)
+Bi iBQMb U bB4099V	4:099 (1:277)		0:002 (0:009)	0:021 (0:040)	5:132 (2:697)	
Rijt U`272`22öb`2+QKK2M/ iBQM V						
`2pBb2 UKBMQ`V		9:758 (4:218)				
`2pBb2 UK DQ`V		12:792 (4:525)				
Dit U2/BiQ`öb /2+BbBQM V						
`2pBb2 UK DQ`V		0:801 (6:185)				7:009 (11:758)
`2pBb2 UKBMQ`V		3:893 (5:145)				13:383 (9:917)
Ij UT`QKBM2M+2V					3:901 (1:589)	3:528 (1:451)
Djt 1 UK DQ`V						27:690 (9:829)
LQX Q#bX	R-kd8	R-kd8	R-j8y	99d	d99	d99
R ²	yXyeN	yXyed	yXk8N	yXy9d	yXRyk	yXRRd
"QmM/bW	(NX8d- RyXky)	(3Xde- 3X38)		(@yXyj- @yXyR)	(yXyd- yXyd)	(ke>
J2 M /2TX p`X8jXjN8	8jXjN8	yXk98	RXeeN	edXkkd	edXkkd	
u2`	3	3	3	3	3	3

LQi20KB;m`2b+Q`2bTQM/ iQ +Q2{+B2Mib 7`QK8/bBkM BM/3WkMAMBQMtiQT T M2H- r2 T`Qtv 7Q`
;2M/2`mbBM; i?2 ;2M/2` Q7 i?2 +Q`2bTQM/BM; mi?Q`c BM i?2 #QiiQK T M2H- r2 +QKT`2 bQ
bQHQA@K H2@ mi?Q`2/ T T2`bX ai M/` / 2`Q`b +Hmbi2`2/ #v`272`22 U+QHmKMb URV UkVV-
bTQM/BM; mi?Q`U+QHmKMb U8V UeVV BM T`2Mi?2b2bX - M/ bi iBbiB+ HHvbbB;MB}+ M

mi?Q`b`2H iBp2 iQ T T2`b #v K H2 +Q``2bTQM/BM; mi?Q`b- M/ NXe / vb H
72K H2 mi?Q`b +QKT `2/ iQ T T2`b #v K H2 bQHQ mi?Q`bX "Qi? ;2M/2` ; Tb
r2 T`QtvQjQmbBM; MDjt U+QHmKM UkVVX
a2+QM/- `272`22b `2 H2bb HBF2Hv iQ `2+QKK2M/ ++2TiBM; 72K H2@ mi?
Rb?Qrb`2bmHib 7`QK 2biBKeVbmB1Mm iBQMI2U` T`Q# #BHBiv KQ/2HX 1p2`v`
`272`22b `2 #Qmi j T2`+2Mi H2bb HBF2Hv iQ `2+QKK2M/ ++2TiBM; T T2`b #
+QKT `2/ iQ bBKBH `[m HBiv T T2`b #v K H2 +Q``2bTQM/BM; mi?Q`bX q?
bQHQ@ mi?Q`4//TQT2`bQ R T2`+2Mi M/ Bib bi M/ `/ 2``Q` `Bb2bX Hi?Qm;?
Km+? bK HH2`- i?2 ; T Bb`Qm;?Hv bBQjHbB1M2M?r22T/BQ Q`bQ/2+BbBQM BM i?
`QmM/ U7Q` 72K H2 +Q``2b1T=Q M0B6M;binM? Q/ 12-`Q` yXyk8VX
h?B`/- 72K H2@ m2i?`Q`2`a1j TE2`b

h #H2/BbTH vb `2bmHib 7`QK 2biBK iBM; bBKBH `; 2M/2`; Tb BM iBK2 M/ H
//BiBQM Hjk 2+QM QKB+b M/ }M M+1M2Qm 1M QHb QK2M+HBf/2Bi2 +QKT`2?2Mb
BM7Q`K iBQM r2M2p2v7Q+QM Q?2B/+b `2 7 `KQ`2 HBKBi2/, i?2v QMHv BM+Hm
U}`bi bm#KBbbBQM- }`bi /2+BbBQM M/ }M H ++2Ti M+2V M/ /Q MQi+QMi
BMi2`BK 2/BiQ`B H /2+BbBQM bX L2p2`i?2H2bb- i?2v bm;; 2bi; 2M/2`; Tb BM
`Qm; ?Hv BM HBM2 rBi? i?Qb2R`2b2Mi2/ BM h #H2

AM i?2 i?B` / +QHmK-Mr Q 7 7 Q# H2bmHib7`QK`2;`2bbbBM; T T2`b`o iQi H`QmM/H
;2M/2` +QKTQbBiBQM M/ +Bi iBQMbX *QM bB 7 23MH250?mi23Qn i2/bKBWmbb#HB2T
i?`Qm;? KQ`2`QmM/b Q7`2pB2rX h?2 ; T 7Q`72K H2 +Q`2bTQM/BM; mi
2biBK i2/ BM Rb B#HB2 bBKBH`U M/ KQ`2 T`2+Bb2Hv2biBK i2/V 7Q`bQHQ@72

hQ TT`QtBK i2iBK2 bT2MirBi? mi?Q`b-r2i F2i?2/Bz2`2M+2UBM/ vbV #2i
/2+BbBQM/ i2b- 2t+Hm/BM; T T2`b i? it=20 2 b-B2B-2/BB MQ`Qim Mv`2pBbBQMb
"2+ mb2i?Bb };m`2BM+Hm/2b #Qi?i?2iBK2 mi?Q`b bT2M/`2pBbBM;i?2B`T
M/2/BiQ`b bm#b2[m2MiHv i F2iQ`2pB2ri?2B``2pBbBQMb-r2 //BiBQM HHv
Q7`2pB2r U+QHmKM U9VV M/`2bi`B+i i?2 b KTH2 iQ K Mmb+`BTib ++2Ti2
U8VVX_2bmHib BM i?2 iQT T M2H Q7 +QHmKM U9V `2`Qm;?Hv BM HBM2rBi

h #H2 k, :2M/2` ; Tb BM iBK2 M/ H2M;i? Q7 T22` `2pB2r i jk 2+QM QKB+b

	hBK2 iQ } `bi /2+BbBQM		LQX `QmM/b maxtV		hBK2 7`QK } `bi iQ }M H /2+BbBQM	
	maxt ≤ 1		maxt ≤ 1		maxt ≤ 1	
	HH T T2	UkV	HH T T2`b	UjV	HH T T2`b	U8V
	URV	UkV	UjV	U9V	U8V	
62K H2 +Q` `2bTQM/BM; mi?Q`b						
72K H2	0:431	3:566	0:043	14:562	5:888	
	(0:442)	(1:611)	(0:020)	(3:039)	(2:336)	
+Bi iBQM b U b-5M18V	-4:490	0:015	-11:236	-3:897		
	(0:996)	(1:422)	(0:008)	(2:680)	(1:531)	
maxt				93:558		
				(8:062)		
T`QKBM2M+2				-0:835	-0:876	
				(0:364)	(0:290)	
LQX Q#bX	k9-8RR	Ry-dy3	k9-8ey	kj-Nyd	Ry-y3j	
R ²	yXRee	yXkRy	yXkk3	yX9y3	yXk9d	
"QmM/b U72K H2V	(yX9j- jX8R)	(jX8d- eXjN)	(yXy9- yXy9)	(RRXky- R9X		
J2 M /2TX p `X	RjyX9NR	RjX8dN	kR9XN89	RRkXjRR		
aQHQA@ mi?Q`2/ T T2`b						
72K H2	0:290	8:436	0:078	22:091	12:409	
	(3:051)	(5:040)	(0:024)	(5:025)	(6:879)	
+Bi iBQM b U b-5M32V	-5:513	0:029	-11:767	-4:535		
	(1:341)	(1:868)	(0:007)	(2:947)	(2:008)	
maxt				95:992		
				(10:333)		
T`QKBM2M+2				-6:543	-4:046	
				(1:693)	(1:052)	
LQX Q#bX	e-8jk	k-3de	e-88j			

9 h?2`QH2 Q7 bi iBbiB+ H /Bb+`BKBM iBQM

b /Bb+mbb2/ T`2p p Q`2K HvM bBK2`Q#H2K iB+ T`Qtv 7Q`~~R2V Q`~~li 2Bm2`iPraH B iQm U
1 0 TH mbB#Hv BK T+H B 2+Qim bi2`p iBp2HvA2-biB K +2bmb2`p iBp2HvA2biBK i2b
hQ b22 r?vk 2H2iwig + Tim`2`27Qb2BM7Q`K iBQM UTQQ`Hv M/ r2HH@BM7Q`K
/2}M2iB K2 bi?2 KQM Mij07biBki2Q`b bT2M/`2bTQM/BM; iQ

#bQ`#b i?2 2ti` iBK2 rQK2M bT2M/ +QKTH2iBM; i?2B^{ky`}2pBbBQMb- ?QH/BI

72K H2 mi?Q`b72r2/MVb9k2pBbBM;+QKT`2/iQK2M Ubi M/`/2``Q`R8V-Q`88

.BQM- JX GX- CX GX amKM2`- M/ aX JX JBi+?2HH UkyR3VX ó:2M/2`2/ +Bi iBQ
M/ bQ+B H b+B2M+2 K2iSQ/HQH Q+vHj2MUbJv6 BTX jRk jkdX
.m+?- 2iX HUXyRkVX óh?2 TQbbB#H2`QH2 Q7`2bQm`+2`2[mB`2K2Mib M/ +
;2M/2`/Bz2`2M+2b BM Tm#HB+ iBQ Ma`R2dLWFR BK-T28RqXkX
.m+iQ`- GX- aX :Qv H- M/ X S`mKK2` UkykRVX ó:2MB2r QM/ 1+QQHMQ#QB+iBQM
ai iBbiB7Q`i?+QKBM;VX
.mzv- JX X UkyRdVX óG bi M/ +Q`2bTQM/BM; 1+iQEQ;TV MiB1+2QJHBMMB-QQH Q;
TTX 33de 333dX
.rQ`FBM- 2iX HUXkykyVX óh?2 2ti2Mi M/ /`Bp2`b Q7;2M/2`BK# H M+2 BM M2m`
L im`2 L2m`Qk+B3M+TTX NR3 NkeX
62`#2`- JX X URN3eVX ó*Bi iBQMb, `2i?2v M Q#D2+aiB;2BK Q kbM T2TQ7j3R?QH
j3NX
URN33VX ó*Bi iBQMb M2/M2irQMFBQk+B2M- TTX 3k 3NX
: HH2M- uX M/ JX q bb2`K M UkykkVX óAM7Q`K2/ +?QB+2b, ;2M/2` ; Tb BM +
:m`BMQ- \*X JX M/ oX JX >X "Q`/2M UkyRdVX ó6 +mHiv b2`pB+2 HQ /b M/ ;2
Q7i?2 + /2KB+ 72KBH+V6BM >B;?2`813/b+Vi-BQTMX edk eN9X
>2M;2H- 1X UkykkVX óSm#HBb?BM; r?BH2 72K H2X `2 rQK2M ?2H/ iQ ?B;?2
`2pB2rX0 1+QM QKB+RQ QbèM3M- TTX kN8R kNNRX
>2M;2H- 1X M/ 1X JQQM UkykkVX ó:2M/2` M/ [m HBiv i iQT 2+QM QKB+b DQ
E2HHv- CX- hX a /2;?B2?- M/ EX /2HB UkyR9VX óS22` `2pB2r BM b+B2MiB}
M/ bm`pBp H;2B/Q0X M H Q7i?2 AMi2`M iBQM H 62/2` iBQM Q7 *HBMB+ H
J2/B+BkM 2jv- TTX kkd k9jX
EBM;- JX2JXHUXyRdVX óJ2M b2i i?2B` QrM +Bi2b ?B;?, ;2M/2` M/ b2H7@+Bi i
iBK2aQ+ BmBTX R kjX
EQ{- JX UkyRNVX óAMMQp iBp2 B/2 b M/ ;2M/2` BM2[m HBivôX JBK2QX
G M;- EX M/ X EX@GX aTBix2` UkykyVX ó\_ +2 /Bb+`BK B Q miBMQ MI,QM 2+Q@Q
MQKB+ S2`bJ2B iBp-2bTX e3 3NX
J ii?2rb- aX X- JX PFmMQ@6mDBr ` - M/ X SQbiH2r Bi2 URN3QvX M_H2}MBM
Q7 1+QM QKB+8802Q`vTTX k9d kdjX
J iibbQM- SX- *X CX amM/#2`;- M/ SX G ;2i UkyRRVX óAb+Q`2bTQM/2M+2`2
#B#HBQK2i`B+ bim/v Q7i?2`2H iBQM #2ir22M +Q`2bTaQB/BMI Q k2i? Q+bM/
3dURV- TTX NN Ry8X
J v2`- aX CX M/ CX JX EX \_ i?K MM UkyR3VX ó>Qr/Q2b`2b2` `+? T`Q/m+iBpB
;2M/2`/Bz2`2M+2b 7Q` KmHiBTH2 Tan#B2B+iQBQMBBjV2-MTBQFveqXRenjX
J2 Mb- JX GX M/ CX 6X oQbb URNNeVX óq?Q`2 bQMbr2HH\hrQ bim/B2b Q7 B
Q7/Bz2`2Mi;` /2- #BHBiv- M/ *QM QBH2Q2 H2p2AR190Xkv-iBQXRjN Rd3X
Pbi2`- 1X UkyRNVX ólMQ#b2`p #H2 b2H2+iBQM M/ +Q2{+B2Mi bi °ðÄ ;0+ 0

aK HH- JX GX M/ .X S ;2` UkykyVX óaQ+BQHQ;B+ H T2`0Q2h+NBp2Q Q M+Q@B
MQKB+ S2`bJ2UikBp-2bTX 9N edX
avKQM/b- JX2jXHXyyeVX ó:2M/2` /Bz2`2M+2b BM Tm#HB+ iBQM QmiTmi, iQr
Q7`2b2`+? T2`7SGQ aMP+210XRV- 2RkdX
q2bi- CXiXHXyRkVX óh?2`QH2 Q7 ;2M/2` BM SG P Q H L3UvdVh-i2QèkRBXôX
q`2M- CXi.XHXyydVX óh?2 r`Bi2J"Qb`2iBQ3M6XRV- TTX N33 NNRX
j9UkV- TTX 9kTkNkrj

$$T T 2 M / B + 2 b$$

1M2`;v 1+QMQRkbnTtH2K2Mi H KXiX`X X X X X X X X X X X X X X X X X X
XR LQM@KQMQiQMB+ `2HRijB QMM bBjB Z #2 iX2X X X X X X X X X X X X X X X X X X
Xk _QmM/@#v@`QmM//2bX`XTXBp2xb XB Xi B +x X X X X X X X X X X X X X X X X
Xj _QmM/@#v@`QmM/Qmi+Q X2XT`QX X BX Hi X2X X X X X X X X X X X X X X X X X
X9 _272`22 2tTX`B2MX2X
X8 Hi2`M iBp2 T`QtB2bX7Q`X2MX2 X
Xe 6B;m`2 j- ++QmMiBM; 7Q` Hi2`MXipX`T`QtB2bX7Q`X[m Xi v X X X X X X X

"jk 2+QMQRKB+b M/}M M+2 DQm`M Hb- bmTTHZK2MiHXKi2XBHX X X X X X X X
"XR GBbiQ7 DXQnXMXHb X
"Xk amKK`vb iXB Xi B +x X
"Xj :2M/2`; T?2i2`Q;2M2Biv X`Qbb B QmXMXHbX X X X X X X X X X X X X X X X
"X9 mi?Q`;2M/2`- iQi H`QmM/b M/iBXxiQ`Xi X2XBXBQX X X X X X X X X X X X

* ++QmMiBM; 7Q` //BiBQM H +QM`QHpx`B XH2X X X X X X X X X X X X X X X X
*XR 1/BiQ`}t2/ zzz+xbX
*Xk _272`22 }t2/ zzz+xbX
*Xj C1G-Q/2 }t2/ 2zz+xbX
*X9 mi?Q`bö BMbiBinXiBQMXHXMF X
*X8 mi?Q`T`QKBM XM X2X
*Xe Lmk#2`Q7 +Q@xmX?Q`b X
*Xd J Mmb+`BTiHXMX;i? X

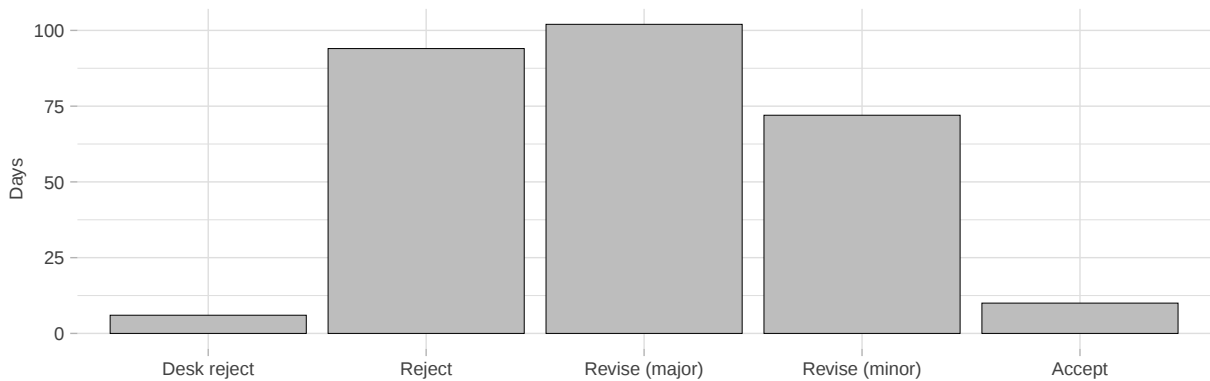
. *mKmH iBp2 ;2M/2`; Tb BM iBK2 bT2MXBM X2pB2X X X X X X X X X X X X X X X X
1 :2M/2`; Tb BM +BiXiBQMX
_272`2M X2X X

1M2` ;v 1+QMQRbB+TbTH2K2Mi H K i2`B H

XR LQM@KQMQiQMB+`2H iBQiMMP/BiB R 2ir22M

b r2 /Bb+mbb B M Xa2Q+MBQ M bQM r Rijt 2b i`BB2+i BM 1[ R/ iBQ #2b mb2`272`22b
TT2` iQ bT2M/ KQ`2 iBK2`2pB2Q MB;DT2 #i2i`b M2?2v bT2M/`2pB2/Q M; T T2`b
`2D2+i- bm;;2biBM; MQM@KQMQiQMB+M/2HpiBQMBQMTiBKi2X2M

h?2 2pB/2M+2 7Q`i?Bb Bb T`X B2MiiTHQMB6iB2mK2/B M KQmMi Q7 iBK2 T T2`b
`272`22b #v 2/BiQ`/2+BbBQM i i?2 2M/ Q7 2 +?`QmM/X Uq2`2TQ`i K2/B M
iQ HBKBi i?2 BKT +i Q7 2ti`2K2 QmiHB2`b, bK HH MmK#2` Q7 T T2`b TT2
b2p2` H v2`b #27Q`2 #2BM; 22M XQMB H v M2D2+BTi r b mM/2``2pB2r 7Q` Q
v2`b #27Q`2 #2BM; /2bF`2D2+i2/XV 1/BiQ`b i F2 K2/B M Q7 e/ vbiQ`2D2-
7Q``2pB2r U/2bF`2D2+iVc i?2 K2/B M`2D2+iBQM /2H v 7Q` T T2`b i?2v/Q
KQM; MQM@`2D2+i2/ T T2`b- i?2 K2/B Mb 7Q``2pBb2 UK DQ`V-`2pBb2 UKB
dk M/ Ry / vb-`2bT2+iBp2HvX



6B;m`2 XR, J2/B M MmK#2` Q7 / vb bT2MirBi?`272`22b M/ 2/BiQ`b- #
LQi2 :` T? THQib i?2 K2/B M KQmMi Q7 iBK2 bT2MirBi?`272`22b M/ 2/BiQ`b #v 2/BiQ`/2+BbB

h?2 b KTH2 mb2/ iQ 2biB X B2M6 B m/2b Rj-jNe mMB[m2 K Mmb+`BTi@`QmM/ B
j-dd9 r2`2 /2bF`2D2+i2/ K Mmb+`BTib- j-9jd r2`2 K Mmb+`BTib`2D2+i2/ 7i2
k-y8kr2`2 6`2pBb2 UK DQ`V6 /2+BbBQMB- R-ded r2`2`2pBb2 UKBMQ`V/2+Bb
LQi2 i? ii?2b2 k-jee ++2Ti2/ Q#b2`p iBQM b+Q`2bTQM/iQ i?2 b K2 mMB[m2

Xk _QmM/@#v@`QmM//2b+`BTiBp2 bi iBbiB+b

h #H2 XR, _QmM/@#v@`QmM//2b+`BTiBp2 bi iBbiB+b 1B12Bvbl7QMQR2+bTm#H

S2`+2Mi ;2 Q7 T T2`b								
_QmM/	62K H2		.2+BbBQM		p;X MQX / vb rBi?			
	P#bX	*Q``X	aQHq	J DQ``2pX	JBMQ``2pX	++2Ti		
y	k-j8N	R9X8	jXedkX9	keXd	yXN	R8kX8		
R	k-jjd	R9Xe	jXd RRXN	jeX8	8RXe	8dXN	NdX9	
k	R-Rje	ReXN	9Xj9X9	RNXe	deXy	kkX8	jkXe	
j	kd9	R8Xd	kXe 9Xy	ReX9	dNXe	RkXN	kkX8	
9Y	dN	R8Xk	dXN eXj	kyXj	djX9	dXN	ReXd	

LQi2K#H2/BbTH vb`QmM/@bT2+B}+/2b+`BTiBp2 bi iBbiB+b 1B12Bvbl7QMQR2+bTm#HBb?2/ BM
h?2}`bi+QHmKM Bb Bbi?2`QmM/- i?2 b2+QM/ +QHmKM Bbi?2 MmK#2` Q7 Q#b2`p iBQM

Xj _QmM/@#v@`QmM/ Qmi+QK2 T`Q# #BHBiB2b

AM h #~~12~~2`2TQ`i`2bmHib 7`QK`2;`2bbBM; M BM/B+ iQ` p`B #H2 2[m HiQ
`2D2+iBQM U+QHmKMb URV M/ UjVV Q``2+QKK2M/2/ K DQ``2pBbBQMb +QM

• @ . Ä Ø - ÿ ã €

h #H2 Xj, *Q`2H iBQM b #2ir22M`272`22 2tT2`B2M+2- T T2`+? `+i2`B

	+Bi iBQM b U bBM?	mi?Q`T`QKBM2M+2	M/ BMbiBimiBQM H`MF			
	URV	Ukv	UjV	U9V	U8V	UeV
72K H2 +Q`X	-0.210 (0:105)	-0.032 (0:091)	-2.219 (0:746)	-1.017 (0:401)	0.057 (0:168)	0.327 (0:154)
MQpB+2`27X	-0.347 (0:120)	-0.036 (0:076)	-1.453 (0:633)	-1.338 (0:353)	-0.140 (0:100)	-0.011 (0:114)
72K XH2MQpB+2`27X	-0.442 (0:115)	0.066 (0:121)	1.488 (0:745)	0.720 (0:460)	-0.301 (0:178)	-0.603 (0:183)
+Bi iBQM b U bBM?			0.847 (0:104)	0.521 (0:086)	0.230 (0:022)	0.211 (0:031)
LQX Q#bX	9-dk9	9-dk9	9-dk9	9-dk9	9-dk9	9-dk9
R ²	yX993	yXddd	yXRde	yXe33	yXy9k	yX83k
J2 M /2TX p`X	kXdy y	kXdy y	jXkNN	jXkNN	kX33y	kX33y
72K H2 bQH Q	-0.370 (0:544)	-0.090 (0:520)	-2.834 (1:321)	-1.642 (1:074)	0.019 (0:809)	0.332 (0:764)
MQpB+2`27X	-0.322 (0:111)	-0.053 (0:092)	-1.375 (0:531)	-1.028 (0:351)	-0.097 (0:096)	0.028 (0:148)
72K XH2MQpB+2`27X	-0.295 (0:560)	0.075 (0:560)	1.272 (1:337)	0.368 (1:169)	-0.359 (0:823)	-0.496 (0:802)
+Bi iBQM b U bBM?			0.814 (0:091)	0.507 (0:117)	0.202 (0:024)	0.230 (0:036)
LQX Q#bX	j-kNj	j-kNj	j-kNj	j-kNj	j-kNj	j-kNj
R ²	yX9ke	yXdN8	yXRNj	yXdjk	yXyje	yXeky
J2 M /2TX p`X	kXdR9	kXdR9	jXk3k	jXk3k	kX3j9	kX3j9
u2`	3	3	3	3	3	3
_272`22		3		3		3

LQ2X#H2/BbTH vb +Q2{+B2Mib 7`QK`2;`2bbBM; +Bi iBQM b U bBM?V- mi?Q`T`QKBM2M+
+Bi iBQM b Ur?2`2 TT`QT`B i2V- 72K H2 mi?Q`b?BT- /mKKv p`B #H2 7Q` MQpB+2`272`2
ir22M i?2 H ii2`irQ p`B #H2bX ai M/`2`Q`b +Hmbi2`2/ QM`272`22b BM T`2Mi?2b2bX
bB;MBj+ Mi iRW- 8W M/ RyW-`2bT2+iBp2Hvx

/mKKv p`B #H2 7Q` MQpB+2`272`22b- +QMi`QH HBM; 7Q` bm#KBbbBQM v2
`2H2p MiVX qBi?Qmi`272`22}t2/ 2z2+ib UiQT`QrV- H2bb 2tT2`B2M+2/`272
i F2 HQM;2`iQ`2pB2r- ++mKMH i2 72r2`+Bi iBQM b M/`2 #v H2bb T`QKB
BMbiBimiBQM b U`2K BMBM; 2biBK i2b`2 MQi bB;MBj+ MiHv /Bz2`2Mi 7`QK
}t2/ 2z2+ib- +Q2{+B2Mib`2 BM/BbiBM;mBb? #H2 7`QK x2`Q rBi? QM2 2t+2Ti
MQpB+2`272`22b K v #2 bbB;M2/ K Mmb+`BTib #v H2bb T`QKBM2Mi mi?Q`b
Hi?Qm;? 6B X H 7Q2b MQi +QM bBbi2MiHv bm;;2bi i? i MQpB+2`272`22b`2
iQ`2pB2r T T2`b +QKT`2/ iQ 2tT2`i`272`22b- 2/BiQ`b +QmH/ TH mbB#Hv
2p Hm i2 K H2@ mi?Q`2/ T T2`b M/ ?`/2`@iQ@2p Hm i2 72K H2@ mi?Q`2/
i?2`2p2`b2 BM r v i? ir b?2b Qmir?2M ;;`2; iBM; Qp2`;2M/2`bX q2 i?2`27
+Bi iBQM b U bBM?V- mi?Q`T`QKBM2M+2 M/ BMbiBimiBQM H`MF QM 72K
TQQ`Hv BM7Q`K2/`272`22b- i?2B`B Mi2`+iBQM M/- r?2`2 T T2`B i2- +E
/2i B Hb QM ?Qr BMbiBimiBQM H`MFr b + H+mH i2/XY P2bHmH2biB T22b2Mi
+QHmKM b U8V M/ UeV TH mbB#Hv`27mi2 i?2 p HB/Biv Q7 Qm`bbmKTiBQM
T T2`b bbB;M2/ iQ MQpB+2`272`22b`2?`/2`iQ 2p Hm i2 b T`QtB2/ 7Q`#
iQ K H2@ mi?Q`2/ T T2`bc i?2 QTTQbBi2 Bb i`m2 7Q`2tT2`i`272`22bX U>Qr
`MF BM 6B/Q22 MQi +? M;2 Qm`;2M2`H +QM X H T22QMBX V 22M6BQM i2 bi-
`2bmHib BM +QHmKM b URV U9V bm;;2bi i? i 72K H2@ mi?Q`2/ T T2`b bbB;
2p Hm i2 +QKT`2/ iQ K H2@ mi?Q`2/ T T2`b M/ i?2`2p2`b2 7Q`2tT2`i`272

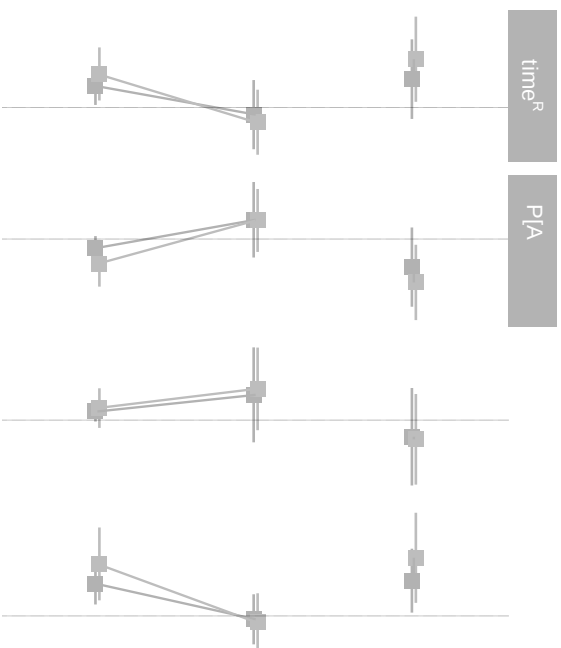
X8 Hi2`M iBp2 T`QtB2b 7Q` ;2M/2`

h?2 7QHHQrBM; i #H2b M/ };m R2M/ 8 B;HBM2i2M; #H22`M iBp2 /2}MBiBQM b Q7 7
i?Q`b? BT#H X 9 M/ 6B;m X 2+ QKT `2 2MiB`2Hv K H2@ mi?Q`2/ T T2`b iQ 2MiB`2H
T T2`bX h #8H2/ 6B;m X 2+ QKT `2 T T2`b rBi? b2MBQ`72K H2 mi?Q`iQ T T2`
K H2 mi?Q` UKBt2/@;2M/2`2/ T T2`b rBi? b2MBQ`hK#H2X em? QB;m2 2t+Hm/
X 8 2TH +2 i?2 #BM `v p `B #H2 Q7 72K H2 mi?Q`b?BT rBi? +QM iBMmQmb
mi?Q`bX AMXh M H 8 B;m X 2 /2}M2 72K H2 mi?Q`b?BT b ? pBM; i H2 bi 8y T
mi?Q`b UKBt2/@;2M/2`2/ T T2`b rBi? 72r2`i? M 8y T2`+2Mi 72K H2 mi?Q`b
X 3 M/ 6B;m X 2+ QKT `2 T T2`b rBi? i H2 bi QM2 72K H2 mi?Q`iQ 2t+HmbBp2H
AM ;2M2` H- `2bmH iX 9 B X 8 h2 #H2K B H `iQ i?Qb2 T`2bX Mi22/b B M i l b #BM/2 +QHmKM
U8V UeV `2 KQbi bBKBH ` - Hi?Qm; ? i?2 X 9 M/ X 2 H M 2? B M h2 #H 2 M 72K H2
mi?Q`b?BT Bb /2}M2/ H2 8 X;-X 2b B`B +i X 2 H y 2b mHib BM +QHmKM b UjV M/ U9V
bB;M2/ +QKT `2/ iQ +Q``2bTQM/BM R 2 b i i B Q m 2 0 B?M v h #H 2 Q`2 MQBbBHv 2biB
h #H2X d M/ X 3 i?2v `2 HbQ Km+? bK HH2` BM K X 10 B i m; 22M/ 2`M; H T #H 2 M / vb
bT2MirBi? `272`22b U+QHmKM b URV UkVV `2 bBKBH `Hv bBx 12/ Q? 2H `;2` +Q
; Tb `2 Km+? bK HH2` U M/ MQi bB;MB}+ MiHv /B X 2 M 2 X i 7`QK x2`QV BM h #H
6B;m` X p X d HHbm;;2bi i? i iBK2 bT2MirBi? mi?Q`b /2+`2 b2b M/ T`Q# #BHBi
r?2M T T2`b `2 `2pB2r2/ #v 2tT2`ib BMbi2/ Q7 MQpB+2b- BM HBM2 rBi? +Q
6B;mj X 2 6B;m X 2 b M/ X 8 b m;;2bi i? i iBK2 bT2MirBi? `272`22b HbQ /2+HBM2b- H
BM 6B;m X 2 b X e M/ X d B b H2bb +H2 `X AM +QM j ` bi rBi? 6B;m`2

X8XR 1t+HmbBp2Hv 72K H2@ mi?Q`2/

h #H2 X9, R #H2HmbBp2Hv 72K H2@ mi?Q`2/

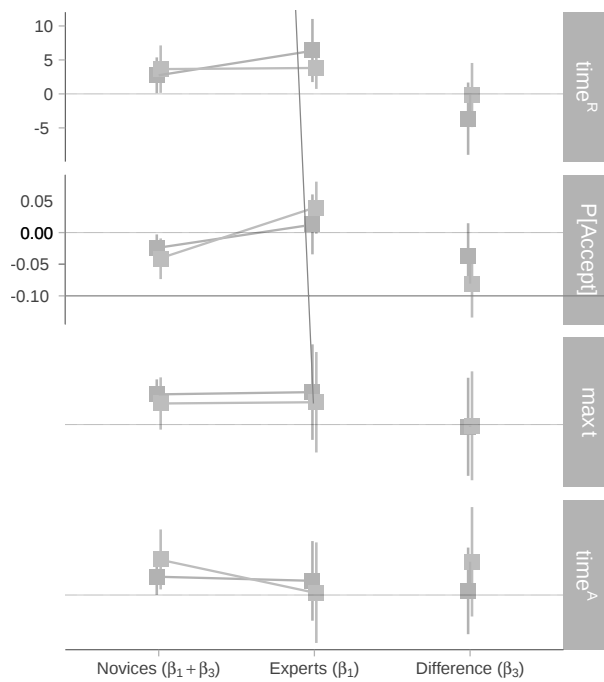
	1[M X W		1[M X eW	1[M X iW	1[M X W		
	. v b b T 2 M i r B i ? ` 2 7 2 ` 2 2 2] T i	L Q X ` Q m M / b v b b T 2 M i r B i ?	m i ? Q ` b				
	U R V	U k V	U j V	U 9 V	U 8 V	U e V	
R y y W 7 2 K H 2	6:063 (2:990)	6:443 (3:066)	-0:026 (0:024)	0:093 (0:084)	22:393 (11:278)	22:575 (11:897)	
t U ` Q m M / V	-15:851 (1:024)	-11:727 (1:600)	0:358 (0:018)		-40:615 (2:766)	-27:838 (2:598)	
+ B i i B Q M b U b - 5 1 2 2 V	-5:129 (0:910)		0:007 (0:005)	0:000 (0:018)	-12:177 (2:146)		
R i j t U ` 2 7 2 ` 2 2 ö b ` 2 + Q K K 2 M / i B Q M V							
` 2 p B b 2 U K B M Q ` V		5:583 (2:049)					
` 2 p B b 2 U K D Q ` V		8:532 (2:512)					
D i t U 2 / B i Q ` ö b / 2 + B b B Q M V							
` 2 p B b 2 U K D Q ` V		4:625 (3:353)				7:800	
D							



X8Xk a2MBQ`72K H2 mi?Q`

h #H2 X8, ~~R~~ #H2 MBQ`72K H2 mi?Q`

	1[MX8W · vb bT2MirBi?`272`22öb`2+QKK2M/ iBQM V` URV UkV		1[MXeW · vb bT2MirBi?`272`22öb`2+QKK2M/ iBQM V` UjV	1[MXhW LQX`QmM/`vb bT2MirBi?` U9V	1[MX3W · vb bT2MirBi?` U8V	mi?Q`b UeV
b2MBQ`72KX	3:932 (1:424)	4:386 (1:465)	-0:019 (0:011)	0:074 (0:040)	8:299 (4:784)	8:244 (4:829)
t U`QmM/V	-15:884 (0:977)	-12:596 (1:636)	0:363 (0:016)		-41:731 (2:338)	-28:562 (2:179)
+Bi iBQM b U b-5M21V	-5:121 (0:836)		0:002 (0:004)	0:011 (0:015)	-11:683 (1:799)	
Rijt U`272`22öb`2+QKK2M/ iBQM V` `2pBb2 UKBMQ`V		5:458 (1:791)				
`2pBb2 UK DQ`V		7:171 (2:272)				
Dit U2/BiQ`öb`/2+BbBQM V` `2pBb2 UK DQ`V		2:946 (3:217)				2:397 (7:497)
`2pBb2 UKBMQ`V		2:571 (1:991)				5:601 (4:509)
Ij UT`QKBM2M+2V					-1:181 (0:381)	-1:398 (0:291)
Djt 1 UK DQ`V						43:873 (4:212)
LQX Q#bX	d-y99	d-y99	d-9dj	k-j8N	j-3RN	j-3RN
R ²	yXy3j	yXydR	yXkd8	yXyjd	yXRR9	yXRje
"QmM/`WU	(jXRd- jXNj)	(9Xy3- 9XjN)		(@yXyk- @yXyk)		(yXyd- yXyd) (eXRj



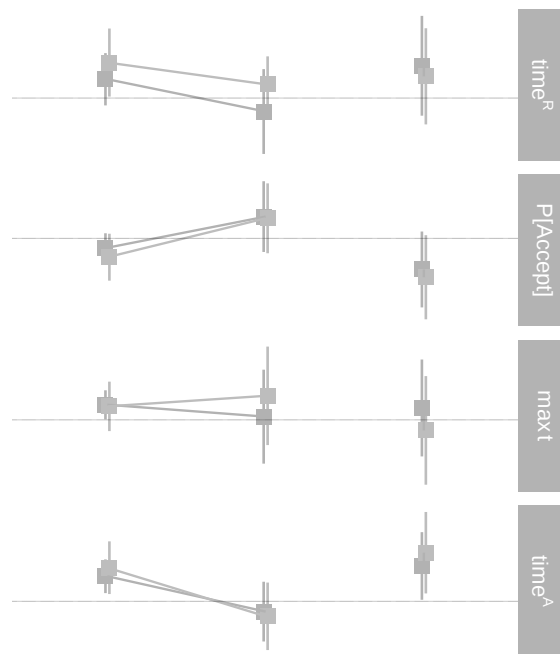
6 B ; m ` 2 X 9 , 6 - B q 2 n M B Q ` 7 2 K H 2 @ m i ? Q `

L Q i 2 1 b i B K i 2 b ` 2 B / 2 M i B + H i Q i ? Q b 2 B M ? 6 B i ? 2 B M / 2 T 2 M / 2 M i p ` B # H 2 7 2 K H 2 ? b # 2 2 M ` 2 T H / m K K v p ` B # H 2 2 [m H i Q R B 7 T T 2 ` ? / i H 2 b i Q M 2 7 2 K H 2 m i ? Q ` r ? Q ? / T ` 2 p B Q m b H v T m # H B M M 2 ` ; v 1 + Q M Q K B 2 b + Q @ m i ? Q ` b i i ? 2 i B K 2 i ? 2 T T 2 ` B M [m 2 b i B Q M r b T m # H B b ? 2 / X U J B t 2 / @ b 2 M B Q ` K H 2 + Q @ m i ? Q ` ` 2 2 t + H m / 2 / X V

X8Xj _ iBQ Q7 72K H2 mi?Q`b

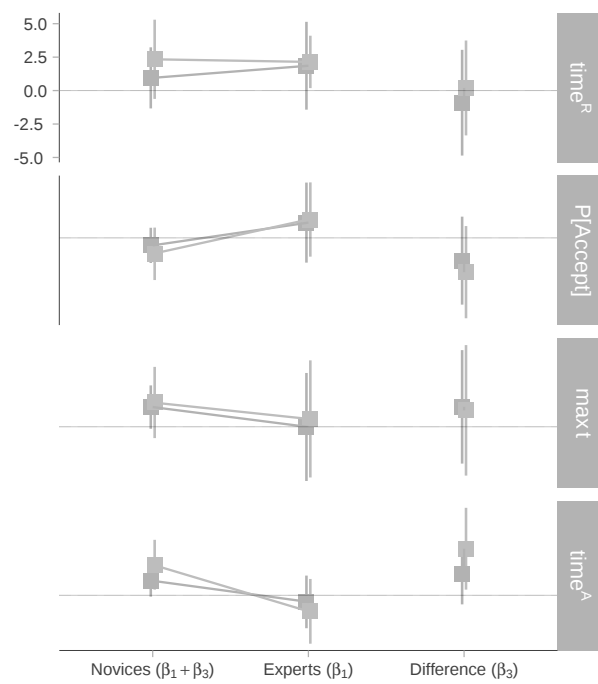
h #H2 Xe, R #H2BQ Q7 72K H2 mi?Q`b

	1[M X 8V		1[M X eW	1[M X dV	1[M X 3V		
	. vb bT2MirBi? `272`222Ti		LQX`QmM/bvb bT2MirBi?		mi?Q`b		
	URV	UkV	UjV	U9V	U8V	UeV	
72KX`iBQ	2:769 (2:187)	2:822 (2:249)	-0:018 (0:019)	0:074 (0:062)	15:227 (7:761)	15:625 (7:976)	
t U`QmM/V	-15:796 (0:982)	-12:415 (1:640)	0:362 (0:016)		-41:613 (2:341)	-28:514 (2:179)	
+Bi iBQMb U b-5:005V			0:002 (0:004)	0:010 (0:015)	-11:703 (1:804)		
R _{ijt} U`272`22öb`2+QKK2M/ iBQM V							
`2pBb2 UKBMQ`V		5:443 (1:805)					
`2pBb2 UK DQ`V		7:344 (2:287)					
D _{it} U2/BiQ`öb /2+BbBQM V							
`2pBb2 UK DQ`V		3:149 (3:231)				2:499 (7:498)	
`2pBb2 UKBMQ`V		2:760 (2:003)				5:636 (4:518)	
I _j UT`QKBM2M+2V					-1:338 (0:381)	-1:543 (0:287)	
D _{jt} 1 UK DQ`V						43:812 (4:224)	
LQX Q#bX	d-yye	d-yye	d-9jk	k-j9e	j-dN3	j-dN3	
R ²	yXy3R	yXye3	yXkd9	yXyjd	yXRR9	yXRjd	
"QmM/pW	(kX99- kXdd)	(kX89- kX3k)		(@yXyk- @yXyk)	(yXyd- yXyd)	(RjXj8	
J2 M /2TX p`X	8jXj8N	yXkdk		RXekk	dRXkjR	dRXkjR	
u2`	3	3	3	3	3	3	
LQi2XBiBK i2b`2B/2MiB+ HiQ R2Qb2BM?hi#H2 BM/2T2M/2Mi p`B #H2 72K H2 ? b #22M`2TH +QM iBMmQmb p`B #H2 2[m HiQ i?2`iBQ Q7 72K H2 mi?Q`b QM T T2`X - M/ bi iB 8W M/ RyW-`2bT2+iBp2HvX							



6 B;m`2 X8, 6-B;mB Q Q7 72K H2 mi?Q`b
 LQ i2 1biBK i2b `2 B/2MiB+ H iQ i?2 Q 2BM?6Bi?2 BM/2T2M/2Mi p`B #H2 72K H2 ? b #22M`2TH
 +QM iBMmQmb p`B #H2 2[m H iQ i?2` iBQ Q7 72K H2 mi?Q`b QM T T2`X

6 B;m`2 Xe, 6-B8ymT2`+2Mi 72K H2 mi?Q`b
 LQi2 1biBK i2b `2 B/2MiB+ H iQ i?Qb2BM?6Bi?2 BM/2T2M/2Mi p`B #H2 72K H2 ? b #22M`2TH
 /mKKvp`B #H2 2[m HiQ RB7 i H2 bi 8y T2`+2Mi Q7 mi?Q`b `2 72K H2 M/y Qi?2`rBb2X UJBt2
 i? M 8y T2`+2Mi 72K H2 mi?Q`b `2 2t+Hm/2/XV



6 $B ; m^2 \times d$, $\beta B ; m^2$

""Qmmi2X
jk 2+QM QKB+b M/ }M M+2 DQm`M Hb- bmTTH2K2M

"XR GBbi Q7 DQm`M Hb

h #H"X R HBbib i?2 jk 2+QM QKB+b M/ }M M+2 DQm`MX kM/r2M/2Hb+b`B B M B M+a B Qi M
jXjXk"2+ mb2 DQm`M Hb #2; M K M ;BM; i?2B`bm#KBbbBQMbi?`Qm;? 11J i
Bb MQi # H M+2/ +`Qbb DQm`M H M/ v2 `X

h #H2 "XR, h?2 jk 2+QM QKB+b M/ }M M+2 DQjXj M kHb M Hvb2/ BM a

CQm`M H	u2 `b +Qp2`2/			
	am#KBbbBQm#HB+ iBQM v2 ` v2 ` P#bX			
1+QM QKB+ JQ/2HHBM;	ky y8 kyRN	ky ye kyRN		k-NRN
1+QM QKB+ avbi2Kb	ky y3 kyRN	ky yN kyRN		
1+QM QKB+b G2ii2`b	ky y9 kyRN	ky y9 kyRN		9-ed8
1m`QT2 M 1+QM QKB+ _2pB2r	ky yk kyRN	ky yj kyRN		R-kyd
1m`QT2 M CQm`M H Q7 SQHBiB+ H 1+QWQ KyR3	ky y8 kyRN	ky ye kyRN		
:HQ# H 6BM M+2 CQm`M H	ky R9 kyRN	ky R8 kyRN		
AMi2`M iBQM H _2pB2r Q7 1+QM QKB+b	ky RY/ 6BMNM+2kyRy kyRN			
C T M M/ i?2 qQ`H/ 1+QM QKv	ky y8 kyRN	ky y8 kyRN		
CQm`M H Q7 " MFBM; M/ 6BM M+2	ky yd kyRN	ky y3 kyRN		k-k8e
CQm`M H Q7 "2? pBQ` H M/ 1tT2`BK2M	ky y8 kyRN	ky y9 kyRN		
CQm`M H Q7 *QKKQ/Biv J `F2ib	ky R8 kyRN		8d	
CQm`M H Q7 *Q`TQ` i2 6BM M+2	ky y9 kyRN	ky y8 kyRN		
CQm`M H Q7 .2p2HQTk2Mi 1+QM QKB+b	ky y9 kyR3	ky y8 kyRN		
CQm`M H Q7 1+QM QKB+b h?2Q`v	ky Rj kyRN	ky Rj kyRN		
CQm`M H Q7 1+QM QKB+b M/ "mbBM2	ky ye kyR3	ky yd kyRN		
CQm`M H Q7 1KTB`B+ H 6BM M+2	ky y8 kyR3	ky ye kyRN		
CQm`M H Q7 1MpB`QMK2Mi H 1+QM QK	ky RY/ 6BMNM+2kyRy kyRN			
CQm`M H Q7 6BM M+B H AMi2`K2/B iBQM	ky Rj kyR3	ky Rj kyRN		
CQm`M H Q7 6BM M+B H ai #BHBiv	ky ye kyR3	ky ye kyRN		
CQm`M H Q7 >QmbBM; 1+QM QKB+b	ky ye kyR3	ky ye kyRN		
CQm`M H Q7 AMi2`M iBQM H 1+QM QK	ky yd kyR3	ky yd kyRN		
CQm`M H Q7 J +`Q2+QM QKB+b	ky y8 kyRN	ky ye kyRN		
CQm`M H Q7 J i?2K iB+ H 1+QM QKB+b	ky y8 kyRN	ky ye kyRN		
CQm`M H Q7 JQM2i `v 1+QM QKB+b	ky y9 kyRN	ky y8 kyRN		
CQm`M H Q7 JmHiBM iBQM H 6BM M+	ky y8 kyR3	ky y8 kyRN		
CQm`M H Q7 i?2 C T M2b2 M/ AMi2`M	ky yd kyR3	ky yd kyRN		
LQ`i? K2`B+ M CQm`M H Q7 1+QM QK	ky yd kyR3	ky yd kyRN		
S +B}+@" bBM 6BM M+2 CQm`M H	ky ye kyRN	ky yd kyRN		
_2;BQM H a+B2M+2 M/ l`# M 1+QM QK	ky yd kyRN	ky y3 kyRN		
_2b2 `+? BM AMi2`M iBQM H "mbBM2	ky yd kyR3	ky ye kyRN		
_2bQm`+2 M/ 1M2`;v 1+QM QKB+b	ky y8 kyR3	ky yd kyRN		
_2bQm`+2b SQHB+v	ky yd kyRN	ky y3 kyRN		

LQ i26B`bi+QHmKM HBbib i?2 DQm`M Hb /2b+`B#2 B M/ M Hvb2/ BM a2+iBQM b

C Yh"B•D5T UÐ P € €°

6B;m`2 "XR, amKK `v bi iBbiB+b QM K Mmb+`BTib Tm#HBb?2/ BM jk 2+QM
LQiX :` T? U V /BbTH vbi?2 irQ@v2 `KQpBM; p2` ;2 Q7 i?2 T2`+2Mi ;2 Q7 T T2`b Tm#HBb?2/ M
72K H2 +Q`2bTQM/BM; mi?Q`c :` T? U"V Bb i?2 irQ@v2 `KQpBM; p2` ;2 Q7 i?2 iQi H MmK#
M/ bm#KBii2/ 2 +? v2 `X :` T?b U*V M/ U.V THQi i?2 /Bbi`B#miBQM Q7 `QmM/b #v +Q`2bTQM
MmK#2` Q7 `QmM/b T2`v2 `UirQ@v2 `KQpBM; p2` ;2V-`2bT2+iBp2HvX :` T?b U1V M/ U6V
7`QK bm#KBbbBQM iQ }`bi•iQ

"Xk

VMiG`i2PÀiQ?2@F0HÝ@•đÀ`Q @ÀiPBIM2[@H?HOL6B gmm`2M/2 p€ €`€đp H2MTHg`2pbbBQ2
"Xj` :2M/2` ; T ?2i2`Q;2M2Biv +`Qbb DQm`M Hb

6B;m "Xk 1 THQi i?2 +Q2{+B2Mi QM 72K H2 7`QK`2;`2bbBQM b B/2MiB+ HiQ i?
k2t+2Tii? ib KTH2b `2`2bi`B+i2/iQ Q#b2`p iBQM b 7"Xk b BK B+ mHhv`TDiQmb`M
i?2 ;2M/2` ; T BM iQi H iBK2 mM/2` `2pB2r 7`QK i?2 b K2`2;`2bbBQM mb2/
h #H X KU TT2M./BX h?2 +Q2{+B2Mi QM 72K H2 r?2Mi?21M X T;H2 BQ MBK BB-bi2/i
?B;?HB;?i2/ BM`2/ Q M7Q +P?2`2?b Q Mb /Bb+m b X 26 B;M XZ Qi2BQM Qi B/2MiB7v
i?2 Qi?2`jk DQm`M HbX

h?2`2 Bb [mBi2 #Bi Q7 ?2i2`Q;2M2Biv +`Qbb DQm`M Hb BM ;2M/2` ; Tb BM
M/ T `iB+mH `àh o8•E` `FÐÐ€đi•r?28P- € À°@€h ođ° €Ðđ€hM €rT @m-/ 6B;m`

6B;m`2 "Xk, :2M/2` ; T ?2i2`Q;2M2Biv +`Qbb DQm`M Hb
LQi 6B;m`2b U V U1V THQi i?2 +Q2{+B2Mi QM 72K H2 7`QK `2;`2bbBQMb Bk 2M4BTi H iQ i?Qb2
i? i b KTH2b `2`2bi`B+i2/iQ Q#b2`p iBQMb 7`QK T"XiB b BiKBHD`Qm`TH Q b c i Q ;n2M/2` ; T BM iQ
iBK2 mM/2``2pB2r 7`QK i?2 b K2`2;`2bbBQM mb2/ iQ 2bXBUK T2 2 Q BvK Mb URV iQ M2Q;H2
1+QMqKB2 B;?HB;?i2/ BM`2/X " M/b`2T`2b2Mi NyW +QM}/2M+2 BMi2`p HbX

"X9 mi?Q` ;2M/2`- iQi H `QmM/b M/ iBK2 iQ }`bi /2+BbBQM

h #H2 "Xk, *Q``2H iBQM #2ir22M `QmM/b Q7 `2pB2r M/ iBK2 iQ }`bi

	jk 2+QMX M/ }M M+2 DQmM;Hh+QM QKB+b				
	+Q``X	mi?Q`	bQHQ	mi?Q`	+Q``X mi?Q` bQHQ mi?Q`
	URV	UkV	UjV	U9V	
72K H2	7:007	15:955	18:783	61:979	
	(3:290)	(5:775)	(13:631)	(27:443)	
maxt	-7:852	-7:188	-14:570	-7:272	
	(1:916)	(2:320)	(3:099)	(7:604)	
+Bi iBQM b U b B4699/	-5:334	-27:417	-27:740		
	(1:014)	(1:370)	(2:385)	(6:346)	
72K xH2xt	-3:438	-8:060	-10:042	-40:207	
	(2:287)	(3:845)	(6:364)	(12:583)	
LQX Q#bX	k9-8RR	e-8jk	k-j8N	99d	
R ²	yXRdy	yXRdy	yXRR8	yXRj8	
J2 M /2TX p `X	RjyX9Nj8	Xk9e	R8kX9Nj	R8kXddy	
CQm`M H	3	3			
u2 `	3	3	3	3	

* ++QmMiBM; 7Q` //BiBQM H +QMi`QH p `B #H2b

*XR 1/BiQ` }t2/ 2z2+ib

h #H~~2XR~~M/ 6B;m~~XR~~2THB+ i2~~R~~h M~~H~~B; ~~η~~`22bT2+iBp2Hv- #mi BM+Hm/2 }t2/ 2z
? M/HBM; 2/BiQ`bX

_2bmHib BM~~XR~~M~~H~~B;m~~XR~~2`2 p2`v bBKBH `iQ i?~~Q~~M/ B~~B~~; ~~η~~-#22bT2+iBp2HvX

6B;m`2 \*XR, j6B;Q~~M~~2`QHBM; 7Q` 2/BiQ` }t2/ 2z2+ib
LQi~~2~~ :` T? Bb B/2MiB+ H-iQt6B; ~~η~~m`2bmHib +QMi`QH 7Q` 2/BiQ` }t2/ 2z2+ibX

h #H2 *XR, R #QMi`QH HBM; 7Q` 2/BiQ` }t2/ 2z2+ib

	1[M X W	1[M X eW	1[M X dW	1[M X W		
. vb bT2MirBi?`27Q`222]Ti	LQX`QmM/bv	bT2MirBi?	mi?Q`b			
	URV	UkV	UjV	U9V	U8V	UeV
62K H2 +Q`2bTQM/BM; mi?Q`b						
72K H2	4:506	4:642	-0:026	0:083	10:623	10:476
	(1:592)	(1:608)	(0:014)	(0:044)	(5:259)	(5:418)
t U`QmM/V	-15:069	-10:912	0:364		-42:603	-28:316
	(0:901)	(1:518)	(0:016)		(2:380)	(2:190)
+Bi iBQM b U b	4:706		0:004	-0:017	-12:261	
	(0:837)		(0:004)	(0:014)	(1:796)	
Rijt U`272`22öb`2+QKK2M/ iBQM V						
`2pB bV						
`2pB bV ‡•Đ						

*Xk _272`22 }t2/ 2z2+ib

h #H*~~X~~K 2THB+ i2b~~R~~#m#H2M+Hm/2b }t2/ 2z2+ib 7Q` 2 +? `272`2~~2~~~~X~~j~~0~~2Bb+mbb2
MmK#2` Q7 `272`22b r?Q`2pB2r2/ bQHQ@ mi?Q`2/ T T2`b #v #Qi? b2t2b Bb b
++QmMiBM; 7Q` `272`22 }t2/ 2z2+ib r?2M `2bi`B+iBM; i?2 b KTH2 iQ bQHQ
T M2H Q7 ~~*X~~#~~R~~2`27Q`2 +QKT `2b bQHQ 72K H2@ mi?Q`2/ T T2`b iQ T T2`b
mi?Q`bX :Bp2M i?2 H `;2 MmK#2` Q7 }t2/ 2z2+ib- r2 HbQ /~~Q~~XMQi 2biBK i2 P
Hi?Qm;? `2bmH~~\*X~~B~~2~~2bQ~~K~~2r? iKQ`2 MQBbBHv 2biBK i2/ `~~R~~H +B~~Q~~2mi~~Q~~i~~P~~Q;b2 B
7Q` `272`22 }t2/ 2z2+ib /Q2b MQi TT2 `iQ ? p2 K2 MBM;7mH BKT +iQM i?2
Q7 T22` `2pB2rX

h #H2 *Xk, R #102Mi`QH HBM; 7Q` `272`22 }t2/ 2z2+ib

	1[MX8W . v b b T 2 M i r B i ? ` 2 7 2 ` 2 2 } t 2 / 2 z 2 + i b	1[MXeW P 2 ` 2 2 2 } t 2 / 2 z 2 + i b	1[MXdW L Q X ` Q m M / b b b T 2 M i r B i ?	1[MX3W mi ? Q ` b		
	U R V	U k V	U j V	U 9 V	U 8 V	U e V
62 K H 2 + Q ` ` 2 b T Q M / B M ;						mi ? Q ` b
7 2 K H 2	3:795	3:521	−0:027	0:084	17:593	16:276
	(1:559)	(1:558)	(0:021)	(0:080)	(17:156)	(17:458)
t U ` Q m M / V	−13:847	−10:068	0:446		−46:310	−42:056
	(1:361)	(2:242)	(0:017)		(7:044)	(7:802)
+ B i i B Q M b U b - B M 1 3 V			0:002	0:019	−11:782	
	(1:103)		(0:005)	(0:026)	(4:600)	
Rijt U ` 2 7 2 ` 2 2 ö b ` 2 + Q K K 2 M / i B Q M V						
` 2 p B b 2 U K B M Q ` V		7:995				
		(1:506)				
` 2 p B b 2 U K D Q ` V		7:179				
		(1:796)				
Dit 002 / B i Q ` @ b / 2 + D S • X - d 1 - d ñ C ' • 2 % f O F Û p + G p B b 2 1 1 1 1						

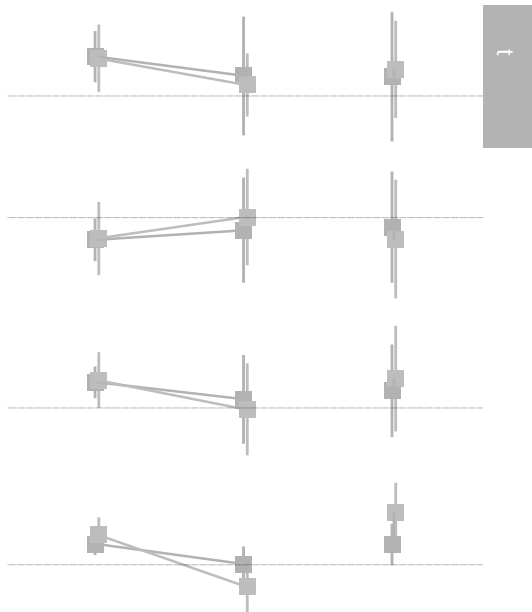
*Xj C1G+Q/2 }t2/ 2z2+ib

h #H*~~X~~j M/ 6B;~~mX~~~~2~~THB+ i2~~R~~hM#H6~~B~~;j~~m~~#~~m~~i BM+Hm/2 }t2/ 2z2+ibC71~~Q~~~~Q~~/22+bQM/ `v
"2+ mb2 72r +Q/2b +QMi BM MQM@M2;HB;B#H2 MmK#2` Q7 bQHq@ mi?Q`
i?2 #QiiQK T M2H*~~Q~~~~j~~+Q~~K~~H22b bQHq@72K H2 mi?Q`2/ T T2`b iQ T T2`b #v K
mi?Q`bX U\_2bmHib 7Q` bQHq@72K H~~2~~@`2mi~~H~~Q2 2/v T 2T2`iB~~2~~2Mi Q BT; mT`22`b #v K
+Q``2bTQM/BM; mi?Q~~9bX~~~~j~~22 a2+iBQM

_2bmHib B~~M~~~~X~~~~j~~ M~~H~~~~Q~~B;~~mX~~~~2~~`2 bBKBH `iQ i?Q~~B~~2MB~~Q~~B;~~j~~~~m~~H2i?Qm;? i?2 +Q2{+B2Mi
QM 72K H2 Bb bK HH2` M/ KQ`2 MQBbBHv 2biBK i2/ BM i?2 #QiiQK T M2H Q

*X9 mi?Q`bö BMbiBimiBQM H` MF

h #H~~2~~9M/ 6B;~~mX2~~2THB+ i2Rm#H2B;~~j#2~~ni BM+Hm/2 }t2/ 2z2+ib 7Q`i?2` MF Q7
BMbiBimiBQMb BM i?2 }2H/b Q7 2M2`;v 2+QM QKB+b M/ }M M+2X _ MFBM;
K Mmb+`BTib Tm~~1#M2~~b92/+QM QKB+bQ`2bTQM/BM; mi?Q` {HB i2/ rBi? i?2 B
q2 i?2M ;`QmT2/ BMbiBimiBQMb BMiQ }p2`Qm;?Hv 2[m HHv bBx2/ ;`QmTbX
_2bmHib BM~~X9~~MH0B;~~mX2~~`2 bBKBH`iQ i?Qb2`2TQM/6BM~~X2~~#H2



6B;m`2 \*Xj, 6B+iQMi`QH HBM; 7Q` BMbiBimiBQM H` MF }t2/ 2z2+i
LQiX :` T? Bb B/2MiB+ H-iQt62Tm`2H`2bmHib +QMi`QH 7Q` BMbiBimiBQM H` MF }t2/ 2z2+ibX

h #H2 *X9, R #Q2Mi`QH HBM; 7Q` mi?Q`bö BMbiBimiBQM H` MF

	1[M X W vb bT2MirBi?`272`22öb`2+QKK2M/ iBQM V	1[M X W UkV	1[M X W UjV	1[M X W U9V	1[M X W U8V	1[M X W UeV	mi?Q`b
62K H2 +Q`2bTQM/BM; mi?Q`b							
72K H2	4:392 (1:629)	4:467 (1:648)	-0:028 (0:014)	0:096 (0:046)	10:645 (5:338)	10:311 (5:515)	
t U`QmM/V	-15:896 (0:969)	-12:723 (1:611)	0:363 (0:016)		-41:906 (2:341)	-28:839 (2:177)	
+Bi iBQM b U b-5M4V			0:002 (0:004)	0:017 (0:015)	-11:388 (1:830)		
R _{ijt} U`272`22öb`2+QKK2M/ iBQM V		5:462 (1:792)					
`2pBb2 UKBMQ`V		7:173 (2:276)					
D _{it} U2/BiQ`öb/2+BbBQM V							
`2pBb2 UK DQ`V		2:738 (3:175)				2:487 (7:482)	
`2pBb2 UKBMQ`V		2:649 (1:978)				5:403 (4:505)	
I _j UT`QKBM2M+2V					-1:014 (0:345)	-1:156 (0:292)	
D _{jt} 1						43:528 (4:204)	
LQX Q#bX	d-y99	d-y99	d-9dj	k-j8N	j-3RN	j-3RN	
R ²	yXy3j	yXydk	yXkd8	yXy9k	yXRR8	yXRj3	
"QmM/bW	(9Xye-9XjN)	(9XkR-9X9d)		(@yXy9-	@yXyj)	(yXy3- yXRy)	(3Xe
J2 M/2TX p`X	8jXk8jXk3y	yXkdk		RXekk	dRXkyN	dRXkyN	
aQH Q@ mi?Q`2/ T T2`b							
72K H2	9:280 (4:150)	8:550 (4:256)	-0:005 (0:035)	0:043 (0:122)	29:518 (17:058)	28:848 (17:354)	
t U`QmM/V	-12:228 (1:298)	-8:640 (1:810)	0:331 (0:029)		-35:272 (5:473)	-27:822 (5:640)	
+Bi iBQM b U b-4M97V			0:001 (0:009)	-0:015 (0:041)	-5:257 (2:654)		
R _{ijt} U`272`22öb`2+QKK2M/ iBQM V		9:787 (4:226)					
`2pBb2 UKBMQ`V		12:682 (4:557)					
D _{it} U2/BiQ`öb/2+BbBQM V							
`2pBb2 UK DQ`V		-0:749 (6:116)					
`2pBb2 UKBMQ`V		3:906 (5:130)					
I _j UT`QKBM2M+2V					-4:043 (1:591)	-3:864 (1:530)	
D _{jt} 1						30:214 (8:657)	
LQX Q#bX	R-kd8	R-kd8	R-j8y	99d	d99	d99	
R ²	yXydy	yXye3	yXkej	yXyee	yXRy9	yXRR8	
"QmM/bW	(NXk3- NXej)	(3XR9- 3X88)		(@yXyR-	@yXyR)	(yXyR- yXy9)	(kjX
J2 M/2TX p`X	8jXj8jXjN8	yXk98		RXeeN	edXkkd	edXkkd	
u2`	3	3	3	3	3	3	
AMbiX`MF	3	3	3	3	3	3	

LQ i2KbiBK i2b`2B/2MiB+ HiQ iR2b2BIM i#H2H`2bmHib+QMi`QH 7Q`i?2`MF Q7 mi?Q`bö
- M/ bi iBbiB+ HHv bB;MB}+ Mi iRW- 8W M/ RyW-`2bT2+iBp2HvX

h #H2 *X8, R #Q2M`QHBM; 7Q`i?2 óT`QKBM2M+2ô Q7 i?2 KQbi T`QKB

	1[Mx8W vb bT2Mi rBi?`272`222]Ti	1[MxeW LQX`QmM/b	1[MxdW LQX`QmM/b	
	URV	UkV	UjV	U9V
62K H2 +Q`2bTQM/BM; mi?Q`b				
72K H2	3:752 (1:617)	3:720 (1:635)	-0:026 (0:014)	0:096 (0:046)
t U`QmM/V	-15:964 (0:967)	-13:143 (1:574)	0:363 (0:016)	
+Bi iBQMb U b-4:179V			0:000 (0:004)	0:018 (0:015)
Ij UT`QKBM2M+2:007		-0:955 (0:192)	0:003 (0:001)	-0:009 (0:003)
Rijt U`272`22öb`2+QKK2M/ iBQM V				
`2pBb2 UKBMQ`V		5:669 (1:774)		
`2pBb2 UK DQ`V		7:168 (2:267)		
Dit U2/BiQ`öb /2+BbBQM V				
`2pBb2 UK DQ`V		1:655 (3:085)		
`2pBb2 UKBMQ`V		2:290 (1:949)		
LQX Q#bX	d-y99	d-y99	d-9dj	k-j8N
R2	yXy3d	yXydN	yXkde	yXy9y
"QmM/pW	(kXde-jXd8)	(kXdy-jXdk)	(@yXyj-	@yXyj) (yXy3-yXRy
J2 M /2TX p`X	8jXk8jXk3y	yXkdk	RXekk	
aQHQA mi?Q`2/ T T2`b				
72K H2	8:497 (4:013)	7:610 (4:115)	-0:002 (0:035)	0:034 (0:125)
t U`QmM/V	-12:383 (1:306)	-9:450 (1:808)	0:331 (0:029)	
+Bi iBQMb U b-3:100V			-0:003 (0:009)	-0:006 (0:041)
Ij UT`QKBM2M+2:181		-1:543 (0:476)	0:013 (0:004)	-0:045 (0:012)
Rijt U`272`22öb`2+QKK2M/ iBQM V				
`2pBb2 UKBMQ`V		9:629 (4:187)		
`2pBb2 UK DQ`V		12:870 (4:515)		
Dit U2/BiQ`öb /2+BbBQM V				
`2pBb2 UK DQ`V		-270032004b001c00480032>]TJ /F30 8.9664 T896048 0 Td[(3)T9 dF32 8		

*Xe LmK#2` Q7 +Q@ mi?Q`b

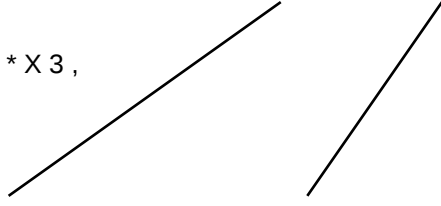
h #H2*XdM/*X3M/ 6B; mX22THB+ i2 i?2 iQT ? Hb2M/kMh6B; jh`22bT2+iBp2Hv-
#mi +QMi`QH 7Q` i?2 MmK#2` Q7 +Q@ mi?Q`b QM T T2`X \_2bmHib `2 p2`v
R M/k M/ 6B; jX2

h #H2 *Xd, RU#QT T M2HV- +QMi`QH HBM; 7Q` MmK#2` Q7 +Q@ m

1[MX8W	1[MXeW
. vb bT2MirBi? `272`222Ti	

h

h #H2 *X3,



h # H2 * X R y , R h # H2

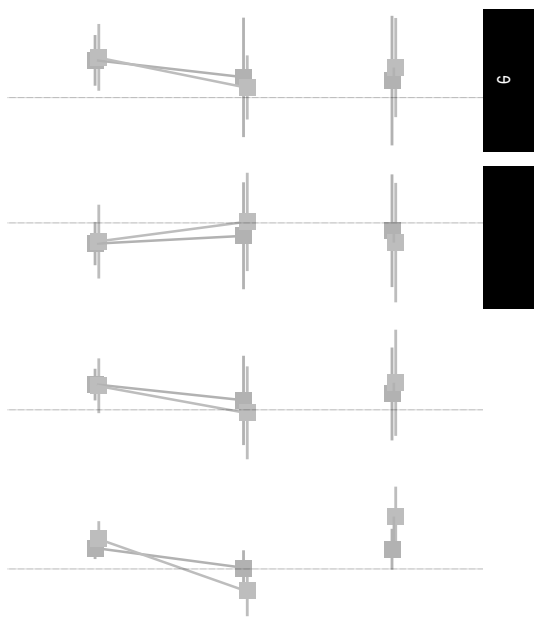
h #H2 *XRR,kh+#QMi`QHhBM;7Q`K Mmb+`BTiH2M;i?

	hBK2 iQ } `bi /2+BbBQM		LQX `QmM/b hBK2 7`QK } `bi iQ }M H /2+BbBQM		maxt`b1
	maxt ≤ 1		maxt V		
	HH T T2`b	HH T T2`b	HH T T2`b	HH T T2`b	
	URV	Ukv	UjV	U9V	U8V
62K H2 +Q`2bTQM/BM; mi?Q`b					
72K H2	0:325 (0:369)	3:487 (1:681)	0:042 (0:021)	13:638 (2:754)	4:873 (2:217)
+Bi iBQM b U bB5M70V	−4:512 (1:008)	−4:512 (1:432)	0:014 (0:008)	−11:771 (2:827)	−4:243 (1:629)
MQX T ;2b	0:269 (0:310)	0:169 (0:297)	0:003 (0:003)	2:522 (0:662)	2:364 (0:316)
maxt				93:369 (8:163)	
T`QKBM2M+2				−0:721 (0:347)	−0:784 (0:271)
LQX Q#bX	k9-8RR	Ry-dy3	k9-8ey	kj-Nyd	Ry-y3j
R ²	yXRee	yXkRy	yXkkN	yX9Ry	yXk8j
"QmM/b U72K H2V (yXjk- jXj9)		(jX9N- eXkd)		(yXy9- yXy9)	(NX38- RjXe
J2 M /2TX p `X	RjyX88d	RXddN	kR9XN89	RRkXjRR	
aQHQ@ mi?Q`2/ T T2`b					
72K H2	−0:109 (3:077)	8:324 (5:086)	0:078 (0:023)	20:446 (5:142)	11:295 (7:198)
+Bi iBQM b U bB5M70V	−5:538 (1:374)	−5:538 (1:902)	0:029 (0:007)	−12:335 (3:133)	−4:823 (2:128)
MQX T ;2b	0:622 (0:321)	0:266 (0:334)	0:001 (0:004)	2:747 (0:882)	2:907 (0:590)
maxt				95:918 (10:293)	
T`QKBM2M+2				−6:012 (1:528)	−3:474 (0:815)
LQX Q#bX	e-8jk	k-3de	e-88j	e-j3y	k-dR8
R ²	yXRed	yXkjj	yXkeR	yX9k9	yXk3R
"QmM/b U72K H2V (@yXRR- RX3j) (dXjR- 3Xjk)		(yXyd- yXy3)			(3Xee- ky
J2 M /2TX p `X	Rj3X88d	RXdd3	ky3XyR9	RykXyR9	
CQm`M H	3	3	3	3	3
u2 `Đ ĐÄ€	3	3	3		

v

U0

RkdX88d



$6B; m^2 * Xe, j6B; QM2`QH HBM; 7Q`K Mmb+`BTi H2M; i?$
 $LQ i\mathbb{Z} :`T? Bb B/2MiB+ H-iQt6B; m^2 H`2bmHib + QMi`QH 7Q`K Mmb+`BTi H2M; i?X$

. *mKmH iBp2 ;2M/2` ; Tb BM iBK2 bT2Mi BM `2pB2r
h #H2XRM/.Xk2biBK i2 i?2 ;2M/2` ; T BM i?2 iQi H MmK#2` Q7 /1w2b;Tv2Mi mM/
1+QMqKB+b

h # H2 .XR, :2M/2` ; Tb BM +mK mH iBp21iB2`2m1+QMQpB2b i

	. vb rBi? `272`22		. vb rBi? mi?Q`b		hQi H / vb	
	URV	UkV	UjV	U9V	U8V	UeV
62K H2 +Q``2bTQM/BM; mi?Q`b						
72K H2	8:826	7:429	24:042	21:120	33:162	29:375
	(2:807)	(2:686)	(9:022)	(9:175)	(13:119)	(13:822)
+Bi iBQM b U b-7100V			-19:124		-53:058	
	(1:326)		(3:083)		(4:666)	
Rij0 U`272`22öb BMBiB H`2+QKK2M/ iBQM V						
`2pBb2 UKBMQ`V		7:787				
		(4:183)				
`2pBb2 UK DQ`V		42:287				
		(4:555)				
`2D2+i		21:957				
		(6:458)				
Dio U2/BiQ`öb BMBiB H /2+BbBQM V						
`2pBb2 UK DQ`V		-66:370		135:266		131:223
		(39:672)		(7:865)		(30:649)
`2pBb2 UKBMQ`V		-73:632		70:760		15:228
		(38:500)		(7:892)		(32:084)
Ij UT`QKBM2M+2V			-1:853	-2:187	-4:306	-6:023
			(0:494)	(0:394)	(1:059)	(0:762)

LQX Q#bX:

h #H2 .Xk, :2M/2` ; Tb BM +mKmH iBp2 iBK2 mM/2` `2pB2r ijk 2+QMqKB+

	62K H2 +Q`X	mi?Q` 62K H2 bQHQ@ mi?Q`2/
	URV	UkV
72K H2	18:191 (3:519)	29:416 (5:922)
+Bi iBQM b U bBM	24:360 (3:622)	-14:133 (3:775)
T`QKBM2M+2	-1:322 (0:494)	-5:750 (1:783)
LQX Q#bX	k9-8Ry	e-8jk
R ²	yXjye	yXjRy
"QmM/b U72K H2V	(R3XRR{KX8-NX9k)	
J2 M /2TX p`X	jjNX3R8	j9yXNdy
CQm`M H	3	3
u2`	3	3

LQi20B;m`2b +Q`2bTQM/ iQ +Q2{+B2Mib 7`QK`2;`2bbBM; i?2 /Bz2`@
2M+2 #2ir22M T T2`öb bm#KBbbBQM M/}M H ++2Ti M+2 / i2b QM i?2
HBbi2/ p`B #H2bX AM+QHmKM URV- r2 T`Qtv 7Q` ;2M/2` mbBM; i?2 ;2M/2`
Q7 i?2 +Q`2bTQM/BM; mi?Q`c BM +QHmKM UkV- r2 +QKT`2 bQHQ@72K H2
mi?Q`2/ T T2`b iQ bQHQ@K H2@ mi?Q`2/ T T2`bX ai M/` / 2`Q`b +Hmb@
i2`2/ #v DQm`M H M/ mi?Q`bö +QmMi`B2b BM T`2Mi?2b2bX - M/
bi iBbiB+ HHv bB;MB}+ Mi iRW- 8W M/ RyW-`2bT2+iBp2HvX

1 :2M/2` ; Tb BM +Bi iBQMb

h #H2X RBbTH vb +Q2{+B2Mib 7`QK `2;`2bbBQM Q7 +Bi iBQMb U bBM?V QM
T`QKBM2M+2- MmK#2` Q7 mi?Q`b M/ DQm`M H M/ v2 ` }t2y k z 2Qib X Ua22 >
2tTH M iBQM M/ DmbiB}+ iBQM Q7 i?Bb bT2+B}+ 1iB Q`M X V+ Q2M Q K B 2bM HvbB
//BiBQM H jk 2+QM QKB+b M/ }M M+2 DQm`M Hb `2 b?QrM BM i?2 }`bi M/ b
+QHmKMb URV M/ UjV- 72K H2 mi?Q`b?BT Bb /2}M2/ b ? pBM; 72K H2 +Q
UkV M/ U9V r2 +QKT `2 bQH Q 72K H2@ mi?Q`2/ T T2`b iQ bQH Q K H2@ mi?

h #H2 1XR, :2M/2` ; Tb BM +Bi iBQMb U bBM?V

	1M2`;v 1+QM QKB+b+QMX M/ }M M+2 DQm`M Hb			
	72KX +Q`X		72KX bQH Q	
	URV	UkV	UjV	U9V
72K H2	-0:037 (0:062)	0:287 (0:156)	0:040 (0:027)	0:057 (0:033)
Tj UT`QKBM2M+2	0:060 (0:006)	0:120 (0:024)	0:028 (0:003)	0:043 (0:010)
MQX mi?Q`b	0:041 (0:020)		0:209 (0:021)	
LQX Q#bX	k-j8N	99d	k9-893	e-88j
R ²	yX93e	yX9kj	yXkd3	yXk98
J2 M /2TX p `XkXe8j		kXedy	kX39e	kX999
CQm`M H			3	3
u2 `	3	3	3	3

LQi2X #H2 /BbTH vb +Q2{+B2Mib 7`QK `2;`2bbBQM Q7 +Bi iBQMb U bBM?V QM
mi?Q`b?BT- +Q@ mi?Q`T`QKBM2M+2- MmK#2` Q7 mi?Q`b M/ DQm`M H M/ v2 ` }
72+ibX ai M/ ` / 2`Q`b +Hmbi2`2/ #v K Mmb+`BTiU} `bi T M2HV M/ DQm`M H M/ n
+QmMi`v Ub2+QM/ T M2HV BM T `2Mi?2b2bX - M/ bi iBbiB+ HHv bB;MB}+ M
8W M/ RyW- `2bT2+iBp2HvX

qBi? i?2 2t+2TiBQM Q7 +QHmKM URbm; 22bmi H?bi B7M Kh #2i@ mi?Q`2/ T T2`b `
KQ`2 i? M K H2@ mi?Q`2/M2 T; 2`b+QM Q72B;+ Bb kN HQ; TQBMib KQM; bQH Q
T T2`bX ii?2 Qi?2` DQm`M Hb- Bi Bb 9 e HQ; TQBMibX

_272`2M+2b

*`/- .X2i HXkykyVX ó`2`272`22b M/2/BiQ`b BM 2+QM QKB+b ;2M/2` M2mi`