



Appendix H

Results of forecasting methods investigated

Explanatory notes

Appendix H summarises the various forecasting techniques investigated for the deposit and withdrawal patterns for differing seasons regarded as possibilities when forecasting these patterns. The methodology is described in detail in Chapter 5.



Appendix H1-1					
A comparison of forecasting techniques applied to total withdrawals					
Season = 6 days (using all available data)					
Forecasting method	Smoothing constants	Seasonality	Measures of forecast error		
			RSME	MAPE	MAD
Simple exponential smoothing	$\alpha = 0.3015$	Simple seasonal relatives	389 330	52.03%	269 769
Simple exponential smoothing	$\alpha = 0.3155$	Moving seasonal relatives	396 126	52.34%	271 859
FIT smoothing (trend = default)	$\alpha = 0.3125$ $\delta = 3.052 \times 10^{-5}$	Simple seasonal relatives	389 950	52.00%	269 544
FIT smoothing (trend = regressed)	$\alpha = 0.3235$ $\delta = 3.052 \times 10^{-5}$	Simple seasonal relatives	389 661	52.40%	269 166
FIT smoothing (trend = default)	$\alpha = 0.3164$ $\delta = 3.052 \times 10^{-5}$	Moving seasonal relatives	396 202	52.34%	271 863
FIT smoothing (trend = regressed)	$\alpha = 0.3135$ $\delta = 3.052 \times 10^{-5}$	Moving seasonal relatives	395 867	52.80%	272 142
Trend regressed exponential smoothing	$\alpha = 0.2987$	Simple seasonal relatives	388 852	52.45%	269 396
Trend regressed exponential smoothing	$\alpha = 0.3126$	Moving seasonal relatives	395 769	52.79%	272 068
Simple average	-	Simple seasonal relatives	374 509	54.69%	271 982
Simple average	-	Moving seasonal relatives	376 408	54.73%	273 307
Moving average	Step = 5	Simple seasonal relatives	384 732	50.20%	258 837
Moving average	Step = 5	Moving seasonal relatives	390 139	50.50%	261 718
Winter's method (trend = default)	$\alpha = 0.2$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	390 028	53.91%	280 178
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	370 683	55.04%	270 157
Winter's method (trend = default)	$\alpha = 0.2$ $\delta = 0$ $\gamma = 0$	Moving seasonal relatives	394 359	54.04%	282 228
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Moving seasonal relatives	372 196	54.41%	268 584



Appendix H1-2					
A comparison of forecasting techniques applied to total withdrawals					
Season = 24 days (using all available data)					
Forecasting method	Smoothing constants	Seasonality	Measures of forecast error		
			RSME	MAPE	MAD
Simple exponential smoothing	$\alpha = 0.0739$	Simple seasonal relatives	302 008	38.58%	219 938
Simple exponential smoothing	$\alpha = 0.0447$	Moving seasonal relatives	310 584	38.71%	218 934
FIT smoothing (trend = default)	$\alpha = 0.0625$ $\delta = 0.0021$	Simple seasonal relatives	301 406	38.54%	220 001
FIT smoothing (trend = regressed)	$\alpha = 0.0234$ $\delta = 0.0157$	Simple seasonal relatives	299 225	38.91%	220 478
FIT smoothing (trend = default)	$\alpha = 0.0312$ $\delta = 0.0157$	Moving seasonal relatives	310 535	39.48%	221 144
FIT smoothing (trend = regressed)	$\alpha = 0.0234$ $\delta = 0.0157$	Moving seasonal relatives	310 609	39.47%	222 111
Trend regressed exponential smoothing	$\alpha = 0.0512$	Simple seasonal relatives	299 050	38.84%	218 993
Trend regressed exponential smoothing	$\alpha = 0.0387$	Moving seasonal relatives	309 959	38.85%	218 807
Simple average	-	Simple seasonal relatives	298 723	39.97%	218 769
Simple average	-	Moving seasonal relatives	316 419	40.88%	218 248
Moving average	Step = 5	Simple seasonal relatives	323 195	38.96%	221 802
Moving average	Step = 5	Moving seasonal relatives	328 715	40.55%	227 278
Winter's method (trend = default)	$\alpha = 0.1$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	343 496	44.92%	245 103
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0.25$ $\gamma = 0$	Simple seasonal relatives	302 954	41.61%	221 002
Winter's method (trend = default)	$\alpha = 0.1$ $\delta = 0$ $\gamma = 0$	Moving seasonal relatives	365 742	45.93%	244 373
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0.15$ $\gamma = 0$	Moving seasonal relatives	319 130	42.36%	226 724



Appendix H1-3					
A comparison of forecasting techniques applied to total withdrawals					
Season = 26 days (using all available data)					
Forecasting method	Smoothing constants	Seasonality	Measures of forecast error		
			RSME	MAPE	MAD
Simple exponential smoothing	$\alpha = 0.0590$	Simple seasonal relatives	306 436	48.43%	239 701
Simple exponential smoothing	$\alpha = 0.0856$	Moving seasonal relatives	351 434	52.71%	265 701
FIT smoothing (trend = default)	$\alpha = 0.0468$ $\delta = 0.0117$	Simple seasonal relatives	303 955	47.56%	238 901
FIT smoothing (trend = regressed)	$\alpha = 0.0468$ $\delta = 0.0117$	Simple seasonal relatives	303 960	47.57%	238 899
FIT smoothing (trend = default)	$\alpha = 0.0771$ $\delta = 0.0625$	Moving seasonal relatives	358 854	50.03%	267 282
FIT smoothing (trend = regressed)	$\alpha = 0.0776$ $\delta = 0.0625$	Moving seasonal relatives	358 489	50.19%	267 412
Trend regressed exponential smoothing	$\alpha = 0.0591$	Simple seasonal relatives	306 452	48.44%	239 710
Trend regressed exponential smoothing	$\alpha = 0.0907$	Moving seasonal relatives	353 808	53.32%	267 078
Simple average	-	Simple seasonal relatives	291 437	44.49%	226 927
Simple average	-	Moving seasonal relatives	326 687	47.69%	238 418
Moving average	Step = 5	Simple seasonal relatives	347 014	49.07%	261 032
Moving average	Step = 5	Moving seasonal relatives	391 174	51.28%	274 856
Winter's method (trend = default)	$\alpha = 0.1$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	313 340	48.45%	245 566
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0.05$ $\gamma = 0$	Simple seasonal relatives	296 798	45.36%	230 338
Winter's method (trend = default)	$\alpha = 0.1$ $\delta = 0$ $\gamma = 0$	Moving seasonal relatives	348 403	51.13%	261 373
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0.05$ $\gamma = 0$	Moving seasonal relatives	331 910	47.12%	236 580



Appendix H1-4					
A comparison of forecasting techniques applied to total withdrawals					
Season = 30 days (using all available data)					
Forecasting method	Smoothing constants	Seasonality	Measures of forecast error		
			RSME	MAPE	MAD
Simple exponential smoothing	$\alpha = 0.0992$	Simple seasonal relatives	337 682	40.24%	210 795
Simple exponential smoothing	$\alpha = 3.052 \times 10^{-5}$	Moving seasonal relatives	412 515	57.96%	261 629
FIT smoothing (trend = default)	$\alpha = 0.1250$ $\delta = 3.052 \times 10^{-5}$	Simple seasonal relatives	338 206	39.90%	209 357
FIT smoothing (trend = regressed)	$\alpha = 0.1250$ $\delta = 3.052 \times 10^{-5}$	Simple seasonal relatives	338 443	41.33%	211 689
FIT smoothing (trend = default)	$\alpha = 3.052 \times 10^{-5}$ $\delta = 3.052 \times 10^{-5}$	Moving seasonal relatives	412 525	57.96%	261 629
FIT smoothing (trend = regressed)	$\alpha = 0.0234$ $\delta = 3.052 \times 10^{-5}$	Moving seasonal relatives	423 579	60.12%	272 043
Trend regressed exponential smoothing	$\alpha = 0.0858$	Simple seasonal relatives	337 942	42.55%	214 794
Trend regressed exponential smoothing	$\alpha = 0.0257$	Moving seasonal relatives	420 144	59.18%	268 490
Simple average	-	Simple seasonal relatives	333 285	43.83%	223 189
Simple average	-	Moving seasonal relatives	392 757	52.39%	242 212
Moving average	Step = 5	Simple seasonal relatives	354 927	40.87%	219 510
Moving average	Step = 5	Moving seasonal relatives	484 344	53.07%	293 756
Winter's method (trend = default)	$\alpha = 0.1$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	342 335	42.67%	222 082
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	334 110	43.30%	223 706
Winter's method (trend = default)	$\alpha = 0.1$ $\delta = 0$ $\gamma = 0.05$	Moving seasonal relatives	403 032	50.43%	246 547
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0.05$ $\gamma = 0$	Moving seasonal relatives	371 368	44.74%	221 923



Appendix H1-5					
A comparison of forecasting techniques applied to total withdrawals					
Season = 6 days (using most recent 56 data points)					
Forecasting method	Smoothing constants	Seasonality	Measures of forecast error		
			RSME	MAPE	MAD
Simple exponential smoothing	$\alpha = 0.3123$	Simple seasonal relatives	433 783	56.61%	290 818
Simple exponential smoothing	$\alpha = 0.3000$	Moving seasonal relatives	449 878	56.42%	291 382
FIT smoothing (trend = default)	$\alpha = 0.3125$ $\delta = 3.052 \times 10^{-5}$	Simple seasonal relatives	433 806	56.61%	290 815
FIT smoothing (trend = regressed)	$\alpha = 0.3128$ $\delta = 3.052 \times 10^{-5}$	Simple seasonal relatives	433 864	56.54%	290 795
FIT smoothing (trend = default)	$\alpha = 0.3125$ $\delta = 3.052 \times 10^{-5}$	Moving seasonal relatives	451 469	56.52%	291 787
FIT smoothing (trend = regressed)	$\alpha = 0.3125$ $\delta = 3.052 \times 10^{-5}$	Moving seasonal relatives	451 489	56.39%	291 769
Trend regressed exponential smoothing	$\alpha = 0.3126$	Simple seasonal relatives	433 839	56.54%	290 785
Trend regressed exponential smoothing	$\alpha = 0.3003$	Moving seasonal relatives	449 981	56.29%	291 360
Simple average	-	Simple seasonal relatives	415 451	62.51%	308 940
Simple average	-	Moving seasonal relatives	420 123	61.38%	307 313
Moving average	Step = 5	Simple seasonal relatives	333 210	45.65%	224 409
Moving average	Step = 5	Moving seasonal relatives	321 613	44.08%	221 423
Winter's method (trend = default)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	415 478	62.66%	309 175
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	415 426	62.00%	309 464
Winter's method (trend = default)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Moving seasonal relatives	420 083	61.28%	307 157
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Moving seasonal relatives	419 981	60.66%	307 722



Appendix H1-6					
A comparison of forecasting techniques applied to total withdrawals					
Season = 24 days (using 56 most recent data points)					
Forecasting method	Smoothing constants	Seasonality	Measures of forecast error		
			RSME	MAPE	MAD
Simple exponential smoothing	$\alpha = 3.052 \times 10^{-5}$	Simple seasonal relatives	289 205	33.94%	201 055
Simple exponential smoothing	$\alpha = 0.0043$	Moving seasonal relatives	391 171	36.38%	212 947
FIT smoothing (trend = default)	$\alpha = 3.052 \times 10^{-5}$ $\delta = 3.052 \times 10^{-5}$	Simple seasonal relatives	289 205	33.94%	201 055
FIT smoothing (trend = regressed)	$\alpha = 3.052 \times 10^{-5}$ $\delta = 0.0078$	Simple seasonal relatives	289 139	33.01%	200 002
FIT smoothing (trend = default)	$\alpha = 0.0043$ $\delta = 0.0156$	Moving seasonal relatives	391 229	36.64%	213 542
FIT smoothing (trend = regressed)	$\alpha = 0.0167$ $\delta = 0.0547$	Moving seasonal relatives	394 524	36.50%	214 149
Trend regressed exponential smoothing	$\alpha = 3.052 \times 10^{-5}$	Simple seasonal relatives	289 082	33.03%	199 930
Trend regressed exponential smoothing	$\alpha = 0.0326$	Moving seasonal relatives	399 563	35.52%	212 361
Simple average	-	Simple seasonal relatives	289 157	34.32%	201 528
Simple average	-	Moving seasonal relatives	394 934	41.45%	232 109
Moving average	Step = 5	Simple seasonal relatives	286 826	30.98%	190 958
Moving average	Step = 5	Moving seasonal relatives	305 407	31.45%	183 103
Winter's method (trend = default)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	294 185	37.03%	207 551
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	291 331	36.48%	206 214
Winter's method (trend = default)	$\alpha = 0$ $\delta = 0$ $\gamma = 0.2$	Moving seasonal relatives	389 034	44.78%	243 614
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0$ $\gamma = 0.2$	Moving seasonal relatives	388 286	43.93%	239 382



Appendix H1-7					
A comparison of forecasting techniques applied to total withdrawals					
Season = 26 days (using 56 most recent data points)					
Forecasting method	Smoothing constants	Seasonality	Measures of forecast error		
			RSME	MAPE	MAD
Simple exponential smoothing	$\alpha = 0.0324$	Simple seasonal relatives	329 690	51.58%	260 070
Simple exponential smoothing	$\alpha = 3.052 \times 10^{-5}$	Moving seasonal relatives	516 250	80.24%	385 390
FIT smoothing (trend = default)	$\alpha = 0.0198$ $\delta = 0.0625$	Simple seasonal relatives	324 878	50.61%	259 087
FIT smoothing (trend = regressed)	$\alpha = 0.0071$ $\delta = 0.0312$	Simple seasonal relatives	320 555	50.05%	255 043
FIT smoothing (trend = default)	$\alpha = 3.052 \times 10^{-5}$ $\delta = 3.052 \times 10^{-5}$	Moving seasonal relatives	516 250	80.24%	385 390
FIT smoothing (trend = regressed)	$\alpha = 0.0068$ $\delta = 3.052 \times 10^{-5}$	Moving seasonal relatives	521 318	81.09%	390 202
Trend regressed exponential smoothing	$\alpha = 0.0073$	Simple seasonal relatives	321 933	50.46%	255 285
Trend regressed exponential smoothing	$\alpha = 0.0066$	Moving seasonal relatives	521 256	81.09%	390 108
Simple average	-	Simple seasonal relatives	318 145	47.66%	253 211
Simple average	-	Moving seasonal relatives	471 847	68.66%	336 619
Moving average	Step = 5	Simple seasonal relatives	348 129	50.53%	263 522
Moving average	Step = 5	Moving seasonal relatives	503 497	63.57%	291 590
Winter's method (trend = default)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	322 562	49.85%	255 380
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0.3$ $\gamma = 0$	Simple seasonal relatives	318 422	49.17%	253 526
Winter's method (trend = default)	$\alpha = 0$ $\delta = 0$ $\gamma = 0.1$	Moving seasonal relatives	443 489	59.34%	296 608
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0$ $\gamma = 0.15$	Moving seasonal relatives	440 629	58.81%	294 033



Appendix H1-8

**A comparison of forecasting techniques applied to total withdrawals
Season = 30 days (using 56 most recent data points)**

Forecasting method	Smoothing constants	Seasonality	Measures of forecast error		
			RSME	MAPE	MAD
Simple exponential smoothing	$\alpha = 0.0146$	Simple seasonal relatives	448 444	46.56%	197 987
FIT smoothing (trend = default)	$\alpha = 0.0153$ $\delta = 0.0625$	Simple seasonal relatives	447 901	46.52%	196 393
FIT smoothing (trend = regressed)	$\alpha = 0.0144$ $\delta = 0.0117$	Simple seasonal relatives	604 661	77.36%	320 977
Trend regressed exponential smoothing	$\alpha = 0.0150$	Simple seasonal relatives	605 731	77.40%	319 083
Simple average	-	Simple seasonal relatives	512 397	61.88%	275 501
Moving average	Step = 5	Simple seasonal relatives	533 851	51.45%	267 328
Winter's method (trend = default)	$\alpha = 0$ $\delta = 0$ $\gamma = 0$	Simple seasonal relatives	444 092	47.67%	216 910
Winter's method (trend = regressed)	$\alpha = 0$ $\delta = 0$ $\gamma = 0.95$	Simple seasonal relatives	439 816	49.51%	211 868