Supplemental file of the paper titled "Univariate Dynamic Screening System: An Approach For Identifying Individuals With Irregular Longitudinal Behavior"

To save some space in the paper of the above title, some technical details and numerical results are presented in this supplemental file. This file has four sections. In Section 1, some statistical properties of the estimator $\widehat{\mu}(t;\widetilde{V})$ discussed in Section 2.1 of the paper are discussed. In Section 2, the adjustment procedure (15) in Li (2011) is described. In Section 3, the cross-validation (CV) procedure used in the paper is described. Both the adjustment procedure and the CV procedure are mentioned in Section 2.1 of the paper. In Section 4, some extra numerical results of the method discussed in the paper are presented.

1 Properties of $\widehat{\mu}(t;\widetilde{V})$

In the proposition below, it is assumed that the bandwidths used in the four steps for estimating $\widetilde{\mu}(t)$, $\widetilde{V}_0(s,t)$, $\widetilde{\sigma}_y^2(t)$, and $\widehat{\mu}(t;\widetilde{V})$ are h_1, h_2, h_3, and h_4, respectively (cf., Section 2.1 of the paper). This proposition gives the uniform weak consistency of the estimator $\widehat{\mu}(t,\widetilde{V})$.

<u>**Proposition S.1**</u> *Assume that both $\mu(t)$ and $\sigma_y^2(t)$ are $(p+1)$th-order continuously differentiable on $[0,1]$; $V_0(s,t)$ is twice continuously differentiable on $[0,1]^2$; there is some constant $\delta_0 > 0$ such that $E|\varepsilon(t)|^{4+\delta_0} < \infty$, for any $t \in [0,1]$; K is symmetric continuously differentiable probability density function on $[-1,1]$; $h_j = o(1)$, for $j = 1,2,3,4$; $1/(mh_1) = o(1)$; $1/(mh_4) = o(1)$; $\log(m)/(mh_2^2) = o(1)$; and $\log(m)/(mh_3) = o(1)$. Let $\varphi_i(t)$ and $\varphi(t)$ be the intensity functions of the counting process $N_i(t) = \sum_{j=1}^{J} I(t_{ij} < t)$ and the process $N(t) = E(N_i(t))$, respectively, and $f_1(\cdot)$ and $f_2(\cdot,\cdot)$ be the density functions of t_{ij} and (t_{ij}, t_{ik}), for each i and any given $j \neq k$. Then, we further assume that $\varphi_i(t)$ and $\varphi(t)$ are positive, bounded and differentiable on $[0,1]$; f_1 has a compact support on [0,1]; $0 < u_T \leq f_1(t) \leq U_T$, for any $t \in [0,1]$, where u_T and U_T are two constants; and both f_1 and f_2 are twice continuously differentiable on their supports. Under all these assumptions, we have*

$$\sup_{t\in[0,1]} \left|\widehat{\mu}(t;\widetilde{V}) - \mu(t)\right| = O_P(h_4^2 + 1/(mh_4)^{1/2}).$$

<u>**Outline of the proof:**</u> We sketch the proof of Proposition S.1 in cases when $p = 1$ below.

The proof in cases with a general p is similar, although the related expressions would be more complicated. First, similar to Theorem 1 in Pan et al. (2009), it can be checked that

$$\sup_{t\in[0,1]} |\widetilde{\mu}(t) - \mu(t)| = O_P\left(h_1^2 + 1/(mh_1)^{1/2}\right).$$

By this result, we can obtain the following results in a similar way to Proposition 1 in Li (2011):

$$\begin{aligned}\sup_{s,t\in[0,1]} \left|\widetilde{V}_0(s,t) - V_0(s,t)\right| &= O_P\left(h_2^2 + \{\log(m)/(mh_2^2)\}^{1/2} + h_1^2 + 1/(mh_1)^{1/2}\right),\\ \sup_{t\in[0,1]} \left|\widetilde{\sigma}_y^2(t) - \sigma_y^2(t)\right| &= O_P\left(h_3^2 + \{\log(m)/(mh_3)\}^{1/2} + h_1^2 + 1/(mh_1)^{1/2}\right).\end{aligned}$$

By these results and the conditions in Proposition S.1, we can conclude that $\widetilde{V}(s,t)$ defined in (5) of the paper is uniformly consistent in probability. This result implies that the elements of $\widetilde{\Sigma}_i^{-1}$ are bounded. Then, the results in Proposition S.1 can be proved in a similar way to that of Theorem 1 in Pan et al. (2009).

2 Adjustment Procedure (15) in Li (2011)

The matrix $\widetilde{V}_0(s,t)$ in (4) of the paper may not be semi-positive definite, and thus it may not be a good estimator of the covariance matrix function $V_0(s,t)$. To overcome this limitation, we can use the adjustment procedure (15) in Li (2011) to effectively regularize it to be a well defined covariance matrix. More specifically, assume that the spectral decomposition of $\widetilde{V}_0(s,t)$ is

$$\widetilde{V}_0(s,t) = \sum_{k=1}^{\infty} \widetilde{\omega}_k \widetilde{\psi}_k(s)\widetilde{\psi}_k'(t),$$

where $\widetilde{\omega}_1 \geq \widetilde{\omega}_2 \geq \cdots$ are the eigenvalues and $\widetilde{\psi}_1(t), \widetilde{\psi}_2(t), \ldots$ are the corresponding eigenvectors. Let $k^* = \max\{k,\ \widetilde{\omega}_k > 0\}$. Then, the adjusted version of $\widetilde{V}_0(s,t)$ is defined to be

$$\widetilde{V}_0^*(s,t) = \sum_{k=1}^{k^*} \widetilde{\omega}_k \widetilde{\psi}_k(s)\widetilde{\psi}_k(t),$$

which has been proved to be a valid covariance function by Hall et al. (2008).

3 Cross-Validation (CV) Procedure

In Section 2.1 of the paper, it is mentioned that the bandwidth h used in $\widetilde{\mu}(t)$, $\widetilde{V}_0(s,t)$, $\widetilde{\sigma}_y^2(t)$, and $\widehat{\mu}(t;\widetilde{V})$ can be chosen by the conventioned cross-validation (CV) procedure. In the statistical literature, the CV procedure provides us a general methodology for choosing smoothing parameters (cf., Qiu 2005, Section 2.4). Here, we describe this method in the context of choosing h for constructing $\widetilde{\mu}(t)$. Bandwidth selection for the other three estimators $\widetilde{V}_0(s,t)$, $\widetilde{\sigma}_y^2(t)$, and $\widehat{\mu}(t;\widetilde{V})$ can be discussed similarly.

Let $\widetilde{\mu}_{-i}(t)$ be the local pth-order polynomial kernel estimator of $\mu(t)$ with the bandwidth h, computed by (3) in the paper from all observed data except the observations of the ith individual, based on the assumption that the error terms in (1) of the paper at different time points are i.i.d. for each individual (cf., the discussion immediately before expression (4)). Then, we define the CV score by

$$CV(h) = \frac{1}{mJ} \sum_{i=1}^{m} \sum_{j=1}^{J} \left[y(t_{ij}) - \widetilde{\mu}_{-i}(t_{ij}) \right]^2 .$$

Then, the optimal value of h can be approximated by the minimizer of $\min_h CV(h)$.

4 Extra Numerical Results

Figure S.1 shows corresponding results in cases considered by Figure 1 in the paper, except that $w = 0.005$ and $ATS_0 = 20$ here.

Table S.1 presents the corresponding results shown in Figure 2 in the paper. Figure S.2 and Table S.2 present the corresponding results for detecting the drifts considered in Figure 1(d)-(f) of the paper.

Tables S.3 and S.4 give the corresponding results in cases considered by Tables S.1 and S.2, respectively, except that $w = 0.005$ and $ATS_0 = 20$ here.

Tables S.5 and S.6 present the actual ATS_0 and ATS_1 values of the chart (8)-(9) for detecting step and drift shifts, respectively, in cases when d is chosen to be 0.2, 0.5, and 1, m is chosen to be 10, 20, and 40, and the other parameters are the same as those in the example of Figure 2 in the paper and Figure S.2 here. Figures S.3 and S.4 show the ATS_0 and ATS_1 values presented in these two tables.

Tables S.7 and S.8 present the actual ATS_0 and ATS_1 values of the adaptive CUSUM chart by Shu and Jiang (2006) for detecting step and drift shifts, respectively, in cases when δ^+_{min} is chosen to be 0.2, 0.4, and 1.0 and other parameters are chosen to be the same values as those in Figures 2

Table S.1: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the chart (8)-(9), along with their standard errors (in parentheses), for detecting step mean shift of the size δ occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $k = 0.1, 0.2$ or 0.5, $d = 2, 5$ or 10, $\omega = 0.001$, and the nominal ATS_0 is 100.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
2	0.1	5	108.745(2.631)	57.160(1.311)	33.802(0.681)	22.408(0.395)	15.844(0.255)
		10	103.519(1.599)	55.147(0.778)	33.075(0.417)	21.777(0.222)	15.444(0.152)
		20	100.152(1.077)	52.888(0.540)	31.914(0.286)	21.269(0.170)	15.085(0.103)
	0.2	5	108.770(2.659)	57.928(1.379)	33.967(0.727)	21.673(0.419)	14.945(0.271)
		10	104.233(1.579)	55.372(0.847)	32.636(0.441)	21.168(0.237)	14.661(0.154)
		20	100.714(1.125)	53.454(0.581)	31.562(0.309)	20.512(0.174)	14.200(0.118)
	0.5	5	107.804(2.617)	60.105(1.565)	35.724(0.895)	21.949(0.514)	14.285(0.321)
		10	103.537(1.629)	57.977(0.911)	34.384(0.516)	21.360(0.307)	13.970(0.188)
		20	100.771(1.103)	56.119(0.643)	33.081(0.367)	20.621(0.226)	13.407(0.133)
5	0.1	5	105.460(2.124)	43.846(0.778)	23.288(0.315)	14.858(0.165)	10.522(0.097)
		10	102.634(1.489)	42.609(0.555)	22.858(0.240)	14.615(0.129)	10.383(0.077)
		20	100.170(1.046)	41.182(0.404)	22.208(0.168)	14.306(0.088)	10.159(0.056)
	0.2	5	104.951(2.047)	43.930(0.801)	22.817(0.336)	13.959(0.171)	9.521(0.099)
		10	102.735(1.493)	42.677(0.599)	22.118(0.258)	13.611(0.129)	9.329(0.077)
		20	100.324(1.014)	41.329(0.424)	21.597(0.174)	13.365(0.093)	9.192(0.057)
	0.5	5	105.246(1.957)	48.984(0.961)	25.039(0.455)	14.208(0.223)	8.893(0.121)
		10	103.70931.537)	47.618(0.724)	24.413(0.352)	13.923(0.178)	8.732(0.092)
		20	100.161(1.002)	46.318(0.495)	23.501(0.232)	13.546(0.118)	8.505(0.066)
10	0.1	5	104.101(2.100)	33.989(0.549)	16.821(0.186)	10.612(0.089)	7.594(0.049)
		10	102.976(1.445)	33.184(0.375)	16.538(0.128)	10.488(0.064)	7.490(0.038)
		20	100.986(1.181)	32.247(0.316)	16.251(0.113)	10.331(0.056)	7.428(0.034)
	0.2	5	103.697(1.935)	34.483(0.597)	16.129(0.200)	9.636(0.087)	6.631(0.049)
		10	101.869(1.340)	33.792(0.401)	15.839(0.142)	9.475(0.068)	6.538(0.036)
		20	100.303(1.105)	32.959(0.356)	15.510(0.119)	9.348(0.058)	6.453(0.033)
	0.5	5	104.030(1.816)	40.554(0.704)	18.317(0.279)	9.739(0.124)	5.985(0.063)
		10	101.594(1.280)	39.569(0.511)	17.973(0.213)	9.532(0.091)	5.873(0.045)
		20	100.261(1.012)	38.425(0.406)	17.235(0.159)	9.278(0.077)	5.745(0.040)

Table S.2: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the chart (8)-(9), along with their standard errors (in parentheses), for detecting drifts considered in Figure 1(d)-(f) occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $k = 0.1, 0.2$ or 0.5, $d = 2, 5$ or 10, $\omega = 0.001$, and the nominal ATS_0 is 100.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
2	0.1	5	108.486(2.614)	80.776(1.691)	65.740(1.190)	56.489(0.929)	50.094(0.777)
		10	103.493(1.649)	77.891(1.055)	63.778(0.766)	55.040(0.563)	48.965(0.463)
		20	100.351(1.109)	75.275(0.725)	62.284(0.524)	53.854(0.413)	47.803(0.339)
	0.2	5	107.122(2.653)	79.872(1.724)	65.248(1.232)	55.811(0.966)	49.211(0.804)
		10	102.388(1.588)	77.405(1.073)	63.368(0.743)	54.665(0.577)	48.355(0.495)
		20	99.059(1.043)	74.825(0.687)	61.760(0.539)	53.214(0.424)	47.315(0.342)
	0.5	5	106.258(2.654)	81.613(1.819)	67.063(1.356)	57.070(1.078)	50.558(0.917)
		10	102.288(1.605)	78.985(1.094)	65.228(0.796)	55.882(0.652)	49.605(0.563)
		20	99.838(1.141)	76.943(0.810)	63.392(0.612)	54.665(0.460)	48.317(0.390)
5	0.1	5	105.840(2.161)	71.774(1.167)	56.724(0.792)	48.079(0.577)	42.446(0.480)
		10	102.408(1.456)	70.076(0.806)	55.609(0.577)	47.340(0.438)	41.759(0.340)
		20	100.103(1.066)	68.533(0.598)	54.536(0.402)	46.488(0.317)	40.960(0.262)
	0.2	5	103.117(2.050)	71.267(1.202)	56.568(0.823)	47.923(0.613)	41.794(0.488)
		10	100.497(1.473)	69.911(0.864)	55.223(0.593)	46.903(0.453)	41.131(0.367)
		20	100.277(1.047)	68.692(0.612)	54.618(0.425)	46.439(0.335)	40.597(0.276)
	0.5	5	103.786(1.978)	74.199(1.236)	59.337(0.889)	50.364(0.698)	44.125(0.559)
		10	102.449(1.525)	72.849(0.976)	58.463(0.695)	49.385(0.532)	43.236(0.434)
		20	99.942(0.997)	71.641(0.635)	57.384(0.479)	48.457(0.376)	42.460(0.303)
10	0.1	5	105.063(2.103)	64.827(0.984)	50.099(0.627)	42.107(0.470)	36.853(0.378)
		10	102.496(1.403)	63.602(0.682)	49.483(0.444)	41.614(0.330)	36.418(0.260)
		20	101.272(1.149)	62.895(0.579)	48.545(0.368)	40.825(0.282)	35.975(0.227)
	0.2	5	103.031(1.939)	65.292(0.961)	50.391(0.644)	42.050(0.487)	36.570(0.379)
		10	100.941(1.343)	64.037(0.705)	49.739(0.451)	41.464(0.341)	36.151(0.280)
		20	99.856(1.107)	63.316(0.581)	48.727(0.384)	40.680(0.286)	35.568(0.224)
	0.5	5	103.174(1.711)	69.963(0.995)	54.422(0.680)	45.497(0.514)	39.387(0.416)
		10	101.279(1.252)	68.831(0.726)	53.599(0.509)	44.729(0.400)	38.963(0.309)
		20	100.860(1.009)	67.647(0.596)	52.733(0.399)	43.942(0.311)	38.288(0.262)

Table S.3: Actual ATS_0 (in the column labeled by $\delta = 0$) and ATS_1 values of the chart (8)-(9), along with their standard errors (in parentheses), for detecting step mean shift of the size δ occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $k = 0.1, 0.2$ or 0.5, $d = 2, 5$ or 10, $\omega = 0.005$, and the nominal ATS_0 is 20.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
2	0.1	5	19.733(0.599)	13.061(0.428)	8.780(0.304)	5.964(0.216)	4.082(0.151)
		10	19.091(0.397)	12.697(0.289)	8.545(0.209)	5.770(0.152)	3.943(0.110)
		20	19.517(0.285)	12.989(0.195)	8.643(0.141)	5.872(0.104)	4.004(0.072)
	0.2	5	20.256(0.604)	13.490(0.447)	9.047(0.314)	6.158(0.223)	4.120(0.158)
		10	19.552(0.404)	12.946(0.297)	8.729(0.209)	5.901(0.156)	4.009(0.116)
		20	20.213(0.297)	13.358(0.213)	8.935(0.154)	5.942(0.102)	4.043(0.075)
	0.5	5	19.956(0.588)	13.301(0.441)	8.954(0.323)	6.089(0.231)	4.037(0.157)
		10	19.309(0.388)	12.857(0.297)	8.594(0.217)	5.797(0.158)	3.913(0.115)
		20	19.802(0.281)	13.121(0.212)	8.772(0.143)	5.930(0.112)	3.971(0.078)
5	0.1	5	19.789(0.492)	11.870(0.298)	7.582(0.191)	5.131(0.125)	3.644(0.089)
		10	20.777(0.384)	12.474(0.231)	7.940(0.141)	5.327(0.089)	3.738(0.060)
		20	20.238(0.236)	12.015(0.141)	7.633(0.091)	5.148(0.060)	3.631(0.043)
	0.2	5	19.721(0.500)	11.939(0.315)	7.555(0.196)	5.024(0.128)	3.491(0.089)
		10	20.715(0.387)	12.404(0.228)	7.876(0.143)	5.187(0.092)	3.611(0.062)
		20	20.234(0.242)	12.129(0.148)	7.576(0.095)	5.044(0.065)	3.495(0.043)
	0.5	5	19.609(0.498)	12.124(0.326)	7.703(0.214)	5.000(0.142)	3.387(0.097)
		10	20.604(0.392)	12.667(0.249)	8.074(0.162)	5.184(0.102)	3.520(0.068)
		20	19.981(0.257)	12.362(0.163)	7.778(0.106)	5.066(0.071)	3.387(0.049)
10	0.1	5	21.043(0.537)	11.256(0.286)	6.759(0.150)	4.505(0.094)	3.228(0.063)
		10	20.292(0.293)	10.783(0.152)	6.531(0.085)	4.384(0.052)	3.164(0.036)
		20	20.866(0.232)	10.965(0.122)	6.656(0.066)	4.463(0.040)	3.209(0.028)
	0.2	5	20.707(0.523)	11.156(0.285)	6.646(0.164)	4.341(0.097)	3.025(0.064)
		10	20.165(0.295)	10.713(0.161)	6.379(0.091)	4.210(0.056)	2.952(0.038)
		20	20.638(0.235)	11.090(0.129)	6.547(0.073)	4.291(0.043)	3.013(0.030)
	0.5	5	20.557(0.500)	11.640(0.309)	6.933(0.189)	4.370(0.119)	2.910(0.075)
		10	20.217(0.296)	11.296(0.182)	6.716(0.113)	4.255(0.068)	2.808(0.044)
		20	20.772(0.246)	11.590(0.143)	6.835(0.089)	4.296(0.053)	2.881(0.034)

Table S.4: Actual ATS_0 (in the column labeled by $\delta = 0$) and ATS_1 values of the chart (8)-(9), along with their standard errors (in parentheses), for detecting drifts considered in Figure 1(d)-(f) occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $k = 0.1, 0.2$ or 0.5, $d = 2, 5$ or 10, $\omega = 0.005$, and the nominal ATS_0 is 20.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
2	0.1	5	20.170(0.625)	16.396(0.487)	13.946(0.397)	12.000(0.336)	10.622(0.287)
		10	19.515(0.391)	16.014(0.325)	13.515(0.268)	11.675(0.222)	10.398(0.200)
		20	20.107(0.294)	16.356(0.235)	13.803(0.190)	11.981(0.163)	10.541(0.137)
	0.2	5	20.048(0.630)	16.284(0.484)	13.790(0.409)	11.882(0.340)	10.549(0.285)
		10	19.526(0.398)	15.876(0.325)	13.424(0.273)	11.616(0.223)	10.321(0.203)
		20	20.017(0.300)	16.237(0.225)	13.672(0.185)	11.890(0.159)	10.541(0.138)
	0.5	5	19.918(0.618)	16.308(0.499)	13.786(0.403)	11.933(0.344)	10.491(0.299)
		10	19.338(0.391)	15.865(0.331)	13.459(0.265)	11.542(0.235)	10.206(0.209)
		20	19.749(0.288)	16.237(0.226)	13.706(0.198)	11.828(0.159)	10.457(0.144)
5	0.1	5	19.825(0.499)	15.588(0.362)	12.976(0.283)	11.297(0.235)	10.064(0.192)
		10	20.948(0.381)	16.284(0.278)	13.556(0.214)	11.675(0.173)	10.330(0.139)
		20	20.324(0.233)	15.922(0.169)	13.228(0.134)	11.460(0.109)	10.149(0.094)
	0.2	5	19.769(0.496)	15.594(0.366)	12.954(0.289)	11.177(0.234)	9.910(0.198)
		10	20.637(0.373)	16.215(0.281)	13.458(0.222)	11.670(0.177)	10.271(0.147)
		20	20.235(0.230)	15.858(0.166)	13.226(0.135)	11.353(0.118)	10.089(0.094)
	0.5	5	19.530(0.486)	15.622(0.385)	13.008(0.294)	11.242(0.241)	9.920(0.209)
		10	20.395(0.376)	16.335(0.294)	13.603(0.221)	11.729(0.191)	10.337(0.156)
		20	19.958(0.243)	15.868(0.180)	13.243(0.147)	11.465(0.119)	10.103(0.100)
10	0.1	5	20.799(0.528)	15.651(0.351)	12.756(0.257)	10.947(0.197)	9.736(0.165)
		10	20.201(0.291)	15.191(0.187)	12.404(0.137)	10.685(0.110)	9.493(0.091)
		20	20.855(0.240)	15.554(0.158)	12.717(0.114)	10.909(0.092)	9.686(0.074)
	0.2	5	20.625(0.512)	15.523(0.353)	12.716(0.251)	10.876(0.211)	9.634(0.173)
		10	20.036(0.288)	15.128(0.193)	12.359(0.150)	10.622(0.120)	9.368(0.099)
		20	20.725(0.245)	15.566(0.162)	12.642(0.115)	10.846(0.094)	9.591(0.079)
	0.5	5	20.710(0.495)	15.869(0.362)	13.028(0.276)	11.159(0.221)	9.809(0.186)
		10	20.162(0.301)	15.405(0.214)	12.676(0.165)	10.927(0.141)	9.636(0.119)
		20	20.718(0.239)	15.869(0.174)	13.087(0.135)	11.142(0.109)	9.817(0.091)

Table S.5: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the chart (8)-(9), along with their standard errors (in parentheses), for detecting step mean shift of the size δ occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 10, 20$ or 40, $k = 0.1, 0.2$ or 0.5, $d = 0.2, 0.5$ or 1, $\omega = 0.001$, and the nominal ATS_0 is 100.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
	0.1	10	109.373(2.592)	67.488(1.910)	45.236(1.421)	30.079(1.008)	20.238(0.768)
		20	105.018(1.928)	67.988(1.419)	45.776(1.030)	30.798(0.785)	20.043(0.566)
		40	99.381(1.233)	66.288(0.882)	44.018(0.695)	29.421(0.481)	19.528(0.351)
	0.2	10	108.259(2.561)	68.260(1.946)	46.119(1.466)	30.734(1.027)	20.453(0.759)
0.2		20	104.961(1.868)	68.753(1.485)	46.482(1.104)	31.013(0.818)	20.429(0.570)
		40	99.369(1.160)	66.605(0.885)	44.974(0.687)	29.851(0.504)	19.245(0.356)
	0.5	10	105.797(2.673)	71.585(2.051)	48.246(1.574)	32.212(1.110)	21.298(0.794)
		20	103.270(1.967)	71.705(1.584)	48.621(1.058)	32.286(0.793)	21.574(0.600)
		40	100.463(1.248)	70.609(0.946)	46.783(0.714)	31.448(0.527)	20.403(0.358)
	0.1	10	107.718(2.016)	63.275(1.384)	41.760(0.933)	28.411(0.647)	19.697(0.451)
		20	103.420(1.512)	62.032(0.998)	40.985(0.682)	27.908(0.467)	19.391(0.308)
		40	100.723(1.189)	64.304(0.771)	41.764(0.524)	28.360(0.361)	19.730(0.242)
	0.2	10	106.053(2.025)	64.185(1.430)	42.060(0.957)	28.422(0.668)	19.458(0.462)
0.5		20	102.819(1.560)	62.749(1.062)	41.078(0.715)	27.509(0.494)	18.877(0.321)
		40	100.434(1.196)	64.748(0.823)	41.962(0.553)	28.349(0.390)	19.247(0.257)
	0.5	10	103.652(1.990)	66.923(1.430)	44.465(1.039)	29.542(0.709)	20.168(0.488)
		20	101.910(1.524)	65.819(1.115)	44.078(0.735)	28.870(0.491)	19.666(0.362)
		40	100.998(1.125)	65.271(0.828)	43.090(0.562)	28.511(0.408)	19.092(0.263)
	0.1	10	105.992(1.890)	62.226(1.138)	39.840(0.679)	26.603(0.438)	19.269(0.293)
		20	103.986(1.475)	61.544(0.870)	39.043(0.537)	26.457(0.335)	18.865(0.232)
		40	100.827(1.021)	60.720(0.615)	38.357(0.380)	26.053(0.234)	18.477(0.163)
	0.2	10	105.185(1.837)	60.852(1.088)	38.752(0.700)	25.676(0.449)	18.194(0.305)
1		20	103.449(1.503)	60.839(0.911)	38.200(0.537)	25.527(0.349)	17.766(0.225)
		40	99.752(0.988)	59.834(0.624)	37.537(0.385)	24.969(0.242)	17.549(0.166)
	0.5	10	104.364(1.889)	63.627(1.252)	40.484(0.820)	26.978(0.526)	17.762(0.335)
		20	102.837(1.481)	63.036(0.951)	40.078(0.625)	26.290(0.391)	17.617(0.257)
		40	100.004(0.981)	62.134(0.661)	38.994(0.424)	25.593(0.279)	17.026(0.179)

Table S.6: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the chart (8)-(9), along with their standard errors (in parentheses), for detecting drifts occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 10, 20$ or 40, $k = 0.1, 0.2$ or 0.5, $d = 0.2, 0.5$ or 1, $\omega = 0.001$, and the nominal ATS_0 is 100.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
	0.1	10	109.468(2.550)	81.658(2.115)	68.062(1.774)	58.819(1.520)	51.098(1.324)
		20	105.751(1.862)	81.231(1.473)	68.890(1.283)	58.416(1.120)	51.563(0.959)
		40	100.322(1.253)	80.247(1.016)	66.888(0.811)	57.348(0.701)	50.250(0.626)
	0.2	10	107.976(2.555)	82.465(2.179)	68.989(1.763)	58.960(1.494)	51.268(1.326)
0.2		20	104.300(1.975)	83.348(1.561)	69.504(1.358)	59.073(1.137)	51.474(0.994)
		40	99.090(1.173)	80.987(1.064)	67.393(0.818)	57.678(0.729)	50.460(0.643)
	0.5	10	105.506(2.748)	85.797(2.234)	71.876(1.876)	61.408(1.585)	53.348(1.371)
		20	103.363(2.013)	86.234(1.605)	72.150(1.317)	61.686(1.120)	53.600(1.017)
		40	100.430(1.273)	84.551(0.996)	70.341(0.854)	60.510(0.737)	52.359(0.640)
	0.1	10	108.727(1.986)	80.231(1.574)	66.935(1.229)	58.360(1.078)	51.630(0.932)
		20	105.112(1.475)	78.250(1.195)	66.093(0.920)	57.685(0.803)	51.027(0.694)
		40	100.228(1.202)	80.780(0.905)	67.543(0.704)	58.912(0.632)	52.205(0.526)
	0.2	10	107.831(2.011)	80.373(1.560)	67.410(1.318)	58.474(1.072)	51.916(0.930)
0.5		20	103.399(1.580)	78.764(1.192)	66.685(0.938)	57.634(0.820)	51.220(0.685)
		40	100.593(1.232)	81.341(0.929)	67.944(0.718)	59.270(0.606)	51.907(0.531)
	0.5	10	105.253(2.009)	80.506(1.584)	67.765(1.265)	59.306(1.085)	52.006(0.951)
		20	102.195(1.620)	79.656(1.217)	67.441(1.011)	58.047(0.830)	51.300(0.707)
		40	100.461(1.175)	81.597(0.925)	69.174(0.797)	59.502(0.661)	52.539(0.536)
	0.1	10	96.536(1.881)	78.380(1.348)	65.113(1.078)	56.644(0.835)	50.540(0.723)
		20	103.940(1.517)	81.611(1.065)	67.598(0.803)	58.775(0.636)	52.218(0.564)
		40	100.827(1.036)	80.398(0.724)	67.089(0.594)	57.874(0.470)	51.535(0.397)
	0.2	10	95.503(1.814)	76.698(1.369)	63.889(1.055)	55.735(0.863)	49.671(0.734)
1		20	103.509(1.399)	79.901(1.015)	66.393(0.763)	57.711(0.686)	51.225(0.554)
		40	100.137(0.989)	78.722(0.720)	65.715(0.519)	57.058(0.457)	50.451(0.378)
	0.5	10	96.211(1.944)	78.558(1.471)	66.026(1.189)	57.139(0.954)	50.479(0.810)
		20	102.222(1.489)	82.069(1.104)	68.512(0.907)	59.291(0.748)	52.345(0.621)
		40	100.444(0.996)	81.059(0.733)	67.556(0.594)	58.079(0.475)	51.612(0.445)

and S.2. Table S.9 presents the actual ATS_0 and ATS_1 values of the RFCuscore chart for detecting step and drift shifts when d and m are chosen to be the same values as those in Figures 2 and S.2. These results in the three tables are shown in Figures S.5-S.7, respectively.

Figure S.8 shows the computed actual ATS_0 and ATS_1 values of the conventional CUSUM chart (8)-(9), the adaptive CUSUM by Shu and Jiang (2006) and the RFCuscore chart by Han and Tsung (2006) in the example of Figures 2 and S.2 when $m = 20$, $d = 2$ ((a) and (d)), 5 ((b) and (e)), and 10 ((c) and (f)), $k = 0.2$ in the chart (8)-(9), and $\delta^+_{min} = 0.4$ in the adaptive CUSUM chart. The results shown in plots (a)-(c) are for detecting step shifts and the ones shown in plots (d)-(f) are for detecting drifts.

Next, we consider cases when observations at different time points are correlated and their error terms follow the AR(1) model (11) in the paper. In such cases, when the IC mean function $\mu(t)$, the IC variance function $\sigma_y^2(t)$, and the IC coefficient ϕ are known, $(\epsilon(t_j^*) - \phi^{\Delta_{j-1}^*}\epsilon(t_{j-1}^*))/\sqrt{1-\phi^{2\Delta_{j-1}^*}}$ are i.i.d. with the standard normal distribution, where $\epsilon(t_j^*) = (y(t_j^*) - \mu(t_j^*))/\sigma_y(t_j^*)$. Thus, in the CUSUM chart (14)-(15), we can use ϕ and $\epsilon(t_j^*)$ in places of $\widehat{\phi}$ and $\widehat{\epsilon}(t_j^*)$ in such cases, and the control limit ρ can be chosen to be those in Table 1 in the paper. Now, let us consider the example of Figure 1 in the paper, except that the error terms of process observations follow the AR(1) model (11) with $\phi = 0.8$, and that the CUSUM chart (14)-(15) with ϕ and $\epsilon(t_j^*)$ in places of $\widehat{\phi}$ and $\widehat{\epsilon}(t_j^*)$ is used for process monitoring. The computed ATS_1 values of the chart, computed from 10,000 replicated simulations, for detecting step shifts and nonlinear drifts in the process mean function are shown in Figure S.9. From the figure, it can be seen that the CUSUM chart (14)-(15), which is based on the standardized error terms, is indeed effective in detecting mean shifts in the original process observations. In this example, the ATS_0 value is fixed at 100. The corresponding results when $ATS_0 = 20$ are shown in Figure S.10. From these results, we can draw similar conclusions to those from the example of Figure 1.

In the example of Figures S.9 and S.10, $\mu(t)$, $\sigma_y^2(t)$ and ϕ are assumed known. In cases when they are unknown, they need to be estimated from an IC dataset. Next, we consider an example where the IC dataset contains observations of m individuals, the error terms of these observations and the observations of new individuals for process monitoring follow the AR(1) model (11) with $\phi = 0.8$, the IC process mean function is $\mu(t) = 1 + 0.3t^{\frac{1}{2}}$ and the process variance function is $\sigma_y^2(t) = 1$, for any $t \in [0, 1]$, and the sampling rate $d = 2, 5$ or 10. Then, the computed actual ATS_0 and ATS_1 values of the CUSUM chart (14)-(15), computed in the same way as those in Figure

Table S.7: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the adaptive CUSUM chart proposed by Shu and Jiang (2006), along with their standard errors (in parentheses), for detecting step mean shift of the size δ occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $\delta_{min} = 0.2, 0.4$ or 1.0, $d = 2, 5$ or 10, $\omega = 0.001$, and the nominal ATS_0 is 100.

d	δ_{min}	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
2	0.2	5	107.938(2.594)	57.185(1.321)	33.688(0.685)	21.789(0.403)	15.223(0.262)
		10	103.333(1.580)	54.965(0.813)	32.843(0.413)	21.323(0.233)	14.921(0.152)
		20	99.997(1.090)	52.894(0.505)	31.677(0.294)	20.673(0.176)	14.583(0.109)
	0.4	5	106.880(2.601)	57.372(1.350)	33.621(0.730)	21.455(0.420)	14.614(0.264)
		10	102.048(1.571)	54.973(0.810)	32.436(0.431)	20.824(0.237)	14.326(0.151)
		20	99.514(1.077)	53.071(0.571)	31.584(0.319)	20.253(0.183)	13.912(0.121)
	1.0	5	108.663(2.661)	61.001(1.557)	35.880(0.876)	22.353(0.526)	14.408(0.315)
		10	104.494(1.585)	58.396(0.937)	34.524(0.514)	21.474(0.302)	14.019(0.187)
		20	102.257(1.125)	56.085(0.651)	33.047(0.400)	20.619(0.214)	13.580(0.140)
5	0.2	5	106.485(2.107)	44.219(0.801)	23.051(0.332)	14.331(0.170)	9.891(0.100)
		10	102.999(1.538)	42.832(0.581)	22.566(0.245)	14.140(0.132)	9.737(0.077)
		20	101.359(1.003)	41.715(0.399)	21.974(0.179)	13.792(0.093)	9.559(0.054)
	0.4	5	106.235(2.108)	44.731(0.844)	23.053(0.353)	13.994(0.180)	9.428(0.102)
		10	102.586(1.516)	43.472(0.608)	22.503(0.266)	13.702(0.135)	9.245(0.081)
		20	100.938(1.053)	41.012(0.426)	21.778(0.180)	13.279(0.100)	9.069(0.059)
	1.0	5	104.728(2.011)	49.243(0.944)	25.113(0.473)	14.277(0.224)	8.945(0.118)
		10	103.187(1.530)	48.035(0.758)	24.642(0.360)	14.046(0.179)	8.775(0.094)
		20	100.884(1.051)	46.202(0.522)	23.432(0.234)	13.526(0.122)	8.537(0.071)
10	0.2	5	106.481(2.068)	34.596(0.592)	16.638(0.200)	10.173(0.09)	7.048(0.053)
		10	104.400(1.400)	33.707(0.398)	16.324(0.140)	10.028(0.067)	6.962(0.037)
		20	102.434(1.115)	32.683(0.330)	15.959(0.118)	9.859(0.056)	6.859(0.035)
	0.4	5	104.116(1.976)	34.785(0.581)	16.289(0.211)	9.608(0.091)	6.510(0.051)
		10	101.893(1.346)	34.053(0.412)	15.916(0.145)	9.465(0.069)	6.413(0.039)
		20	100.366(1.123)	32.834(0.353)	15.563(0.126)	9.280(0.058)	6.343(0.033)
	1.0	5	102.481(1.688)	40.639(0.716)	18.223(0.289)	9.765(0.120)	5.971(0.061)
		10	100.308(1.278)	39.268(0.530)	17.855(0.219)	9.545(0.092)	5.868(0.046)
		20	99.697(1.002)	38.373(0.433)	17.139(0.175)	9.259(0.075)	5.753(0.041)

Table S.8: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the adaptive CUSUM chart proposed by Shu and Jiang (2006), along with their standard errors (in parentheses), for detecting drifts occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $\delta_{min} = 0.2, 0.4$ or 1.0, $d = 2, 5$ or 10, $\omega = 0.001$, and the nominal ATS_0 is 100.

d	δ_{min}	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
2	0.2	5	107.875(2.549)	80.381(1.667)	65.423(1.216)	56.232(0.977)	49.445(0.773)
		10	103.060(1.567)	77.326(1.043)	63.359(0.725)	54.855(0.574)	48.747(0.471)
		20	100.253(1.112)	75.362(0.670)	61.797(0.537)	53.407(0.395)	47.666(0.346)
	0.4	5	106.853(2.668)	80.131(1.731)	65.278(1.276)	56.018(0.988)	49.378(0.807)
		10	102.781(1.608)	77.372(1.062)	63.583(0.778)	54.587(0.611)	48.537(0.507)
		20	99.318(1.144)	75.170(0.730)	61.849(0.526)	53.126(0.431)	47.307(0.339)
	1.0	5	108.296(2.676)	83.014(1.884)	67.930(1.417)	58.033(1.082)	51.330(0.948)
		10	104.479(1.577)	80.631(1.112)	66.214(0.818)	56.877(0.684)	50.041(0.561)
		20	101.888(1.113)	76.266(0.800)	63.297(0.600)	54.439(0.478)	49.009(0.406)
5	0.2	5	106.325(2.133)	72.447(1.197)	57.196(0.797)	48.166(0.603)	42.332(0.487)
		10	103.449(1.543)	70.876(0.884)	56.005(0.595)	47.428(0.454)	41.697(0.371)
		20	101.594(1.031)	69.055(0.627)	54.988(0.441)	46.339(0.324)	40.896(0.249)
	0.4	5	105.567(2.087)	72.606(1.198)	57.341(0.824)	48.380(0.627)	42.370(0.495)
		10	102.624(1.518)	71.176(0.886)	56.388(0.610)	47.344(0.488)	41.764(0.381)
		20	101.154(1.053)	69.317(0.616)	54.936(0.438)	46.315(0.330)	40.499(0.271)
	1.0	5	105.132(2.025)	75.591(1.260)	60.095(0.905)	50.722(0.693)	44.317(0.568)
		10	103.168(1.614)	74.007(0.974)	59.321(0.710)	49.911(0.540)	43.744(0.447)
		20	101.400(1.104)	70.271(0.630)	56.917(0.479)	48.323(0.361)	42.809(0.305)
10	0.2	5	105.882(2.098)	66.078(0.995)	50.619(0.644)	42.320(0.484)	36.986(0.390)
		10	104.213(1.476)	64.935(0.701)	50.005(0.457)	41.917(0.349)	36.614(0.271)
		20	101.956(1.173)	63.709(0.573)	48.490(0.392)	40.497(0.291)	35.789(0.234)
	0.4	5	103.535(1.860)	65.789(0.973)	50.888(0.640)	42.444(0.484)	36.866(0.378)
		10	101.908(1.426)	64.781(0.714)	50.032(0.463)	41.710(0.346)	36.484(0.287)
		20	99.898(1.072)	63.704(0.566)	49.135(0.399)	40.592(0.303)	35.315(0.239)
	1.0	5	102.624(1.738)	69.805(0.992)	54.247(0.679)	45.686(0.538)	39.454(0.426)
		10	100.629(1.271)	68.347(0.722)	53.481(0.512)	44.637(0.398)	38.973(0.308)
		20	99.769(1.002)	67.269(0.592)	52.549(0.401)	43.810(0.313)	38.243(0.257)

Table S.9: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the RFCuscore chart proposed by Han and Tsung (2006), along with their standard errors (in parentheses), for detecting step shifts or drifts occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $\omega = 0.001$, and the nominal ATS_0 is 100.

type	d	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
Step	2	5	108.759(2.670)	59.894(1.495)	35.175(0.817)	22.409(0.489)	15.102(0.305)
		10	104.466(1.676)	57.186(0.859)	33.968(0.501)	21.778(0.277)	14.701(0.180)
		20	102.040(1.151)	55.545(0.630)	32.703(0.348)	21.087(0.195)	14.261(0.132)
	5	5	104.728(2.052)	46.720(0.897)	24.313(0.401)	14.559(0.205)	9.604(0.121)
		10	102.374(1.539)	45.651(0.652)	23.781(0.308)	14.277(0.160)	9.497(0.098)
		20	100.718(1.054)	44.107(0.441)	22.981(0.203)	13.862(0.111)	9.232(0.066)
	10	5	103.160(1.840)	37.513(0.634)	17.470(0.242)	10.006(0.107)	6.606(0.061)
		10	100.775(1.304)	36.505(0.468)	16.985(0.162)	9.867(0.078)	6.492(0.045)
		20	100.219(1.006)	35.578(0.38)	16.595(0.139)	9.641(0.069)	6.372(0.039)
Drift	2	5	108.795(2.631)	82.335(1.835)	67.522(1.313)	57.508(1.041)	50.680(0.872)
		10	104.589(1.571)	79.905(1.074)	65.072(0.797)	56.138(0.623)	49.786(0.533)
		20	102.235(1.182)	76.188(0.773)	62.628(0.554)	54.766(0.440)	48.552(0.366)
	5	5	104.589(2.037)	73.791(1.220)	58.633(0.830)	49.491(0.659)	43.350(0.528)
		10	102.858(1.538)	72.093(0.916)	57.361(0.651)	48.783(0.510)	42.653(0.393)
		20	101.193(1.078)	70.461(0.632)	56.341(0.436)	48.688(0.335)	42.785(0.295)
	10	5	103.601(1.871)	67.695(0.973)	52.576(0.670)	44.811(0.487)	39.132(0.395)
		10	101.651(1.362)	66.541(0.738)	51.993(0.485)	44.071(0.363)	38.772(0.304)
		20	100.672(1.108)	65.808(0.592)	51.599(0.410)	43.995(0.309)	38.353(0.246)

2, are presented in Table S.10 in cases when $m = 10, 30$ or 50, $k = 0.1, 0.2$ or 0.5, the nominal $ATS_0 = 100$, and the process mean function has a step shift of size $\delta = 0, 0.25, 0.5, 0.75$, or 1.0 starting at the initial observation time point. From the table, we can see that the actual ATS_0 values are within 10% of the nominal ATS_0 value of 100 in all cases considered when $m \geq 30$. Compared to the results in Figure 2 of the paper, to achieve the same amount of accuracy of the ATS_0 value, it seems that we require more IC data here, which is intuitively reasonable because the process observations are substantially positively correlated in this example with $\phi = 0.8$. The corresponding results for detecting the drifts considered in Figure S.9(d)-(f) are presented in Table S.11. Results in cases when $ATS_0 = 20$ are presented in Tables S.12 and S.13. Similar conclusions can be made from all these results.

At the end of this section, we consider an example in which the within-subject observations are correlated, but the correlation does not follow the AR(1) model (11) in the paper. In such cases, the block bootstrap procedure discussed in Section 2.4 of the paper will be used in designing our proposed DySS method. Assume that the true IC mean function and the true IC variance function are still those used in the above example, the error term $\epsilon(t)$ in model (6) of the paper follows the model

$$\epsilon(t) = \epsilon(t - \omega) - 0.5\epsilon(t - 2\omega) + e(t),$$

where $e(t)$ is a white noise process with the distribution $N(0, 5/12)$ at each $t \in [0, 1]$. From the above model specification, we can check that $\text{var}(\epsilon(t)) = 1$, for any $t \in [0, 1]$. In computing the value of the control limit ρ from the IC data with m well-functioning individuals by the block bootstrap procedure, we choose $m_1 = m/2$ and $B = 5000$. In cases when $m = 20, 40$ and 60 and all other parameters take the same values as those in the example of Figures 2 and S.2, the computed actual ATS_0 and ATS_1 values of the chart (8)-(9) are shown in Figures S.11 and S.12, respectively, for detecting the step shifts and the drifts. These results are also presented in Tables S.14 and S.15. From these results, it can be seen that the DySS method can still perform well in this example, except that more IC data are required in this case, compared to the cases discussed earlier, to make the actual ATS_0 values to be within 10% of the nominal ATS_0 value.

References

Hall, P., Müller, H.G., and Yao, F. (2008), "Modelling sparse generalized longitudinal observations

Table S.10: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the chart (14)-(15), along with their standard errors (in parentheses), for detecting step mean shift of the size δ occurring at the initial observation time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 10, 30$ or 50, the error terms of the process observations follow the AR(1) model (11) with $\phi = 0.8$, $k = 0.1, 0.2$ or 0.5, $d = 2, 5$ or 10, $\omega = 0.001$, and the nominal ATS_0 is 100.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
2	0.1	10	122.990(7.247)	42.775(2.376)	22.098(0.892)	14.705(0.393)	11.233(0.216)
		30	108.864(3.967)	36.696(1.016)	20.026(0.374)	13.898(0.188)	10.825(0.109)
		50	99.348(3.130)	35.293(0.923)	19.545(0.329)	13.620(0.163)	10.709(0.094)
	0.2	10	122.961(7.169)	42.877(2.460)	21.391(0.899)	13.816(0.396)	10.429(0.214)
		30	108.534(3.951)	36.519(1.066)	19.169(0.380)	12.974(0.182)	10.029(0.107)
		50	99.478(3.070)	34.782(0.928)	18.697(0.341)	12.746(0.159)	9.924(0.092)
	0.5	10	119.339(6.500)	44.277(2.588)	21.008(0.997)	12.641(0.424)	9.103(0.207)
		30	108.183(3.627)	37.853(1.224)	18.394(0.433)	11.706(0.189)	8.687(0.099)
		50	99.696(2.831)	35.527(1.024)	17.833(0.377)	11.388(0.166)	8.538(0.089)
5	0.1	10	118.146(6.522)	40.769(2.400)	20.309(0.962)	12.936(0.443)	9.459(0.230)
		30	103.543(4.377)	34.283(1.167)	17.686(0.382)	11.790(0.180)	8.864(0.105)
		50	100.388(2.794)	33.850(0.896)	17.913(0.334)	11.942(0.156)	8.967(0.092)
	0.2	10	116.569(6.522)	40.684(2.467)	19.584(1.027)	11.968(0.451)	8.547(0.229)
		30	102.667(4.182)	33.929(1.194)	16.842(0.401)	10.819(0.182)	7.967(0.100)
		50	99.976(2.704)	33.437(0.886)	16.978(0.345)	10.934(0.160)	8.065(0.087)
	0.5	10	113.583(5.313)	43.479(2.519)	20.236(1.151)	11.393(0.537)	7.514(0.252)
		30	101.297(3.616)	36.355(1.315)	16.953(0.474)	9.923(0.199)	6.877(0.103)
		50	100.581(2.387)	36.316(0.976)	16.937(0.396)	9.906(0.174)	6.865(0.089)
10	0.1	10	103.459(5.588)	33.962(1.579)	16.996(0.540)	10.997(0.244)	8.100(0.136)
		30	101.938(4.280)	32.360(1.208)	16.527(0.413)	10.813(0.191)	7.989(0.106)
		50	100.391(3.509)	32.200(0.959)	16.467(0.328)	10.764(0.149)	7.975(0.083)
	0.2	10	102.080(5.133)	33.633(1.613)	16.136(0.567)	9.964(0.246)	7.145(0.130)
		30	101.577(3.943)	32.387(1.238)	15.719(0.442)	9.799(0.191)	7.075(0.104)
		50	100.816(3.168)	32.375(0.986)	15.684(0.339)	9.728(0.149)	7.061(0.080)
	0.5	10	102.292(4.208)	38.738(1.711)	18.593(0.707)	9.917(0.309)	6.485(0.149)
		30	100.467(3.162)	37.597(1.339)	17.633(0.556)	9.862(0.244)	6.398(0.117)
		50	100.807(2.566)	37.578(1.052)	17.642(0.418)	9.871(0.188)	6.373(0.090)

Table S.11: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the chart (14)-(15), along with their standard errors (in parentheses), for detecting drifts considered in Figure S.9(d)-(f) occurring at the initial observation time point, in cases when $\mu(t)$, $\sigma_y^2(t)$ and ϕ are estimated from an IC data with m individuals, $m = 10, 30$ or 50, the error terms of the process observations follow the AR(1) model (11) with the true value of $\phi = 0.8$, $k = 0.1, 0.2$ or 0.5, $d = 2, 5$ or 10, $\omega = 0.001$, and the nominal ATS_0 is 100.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
	0.1	10	122.725(7.265)	71.923(3.412)	54.310 2.157)	44.961(1.574)	39.072(1.228)
		30	107.993(3.966)	65.160(1.788)	49.882 1.114)	41.956(0.854)	36.799(0.665)
		50	99.453(3.143)	61.808(1.555)	48.216 1.008)	40.812(0.748)	35.964(0.599)
	0.2	10	121.093(7.059)	71.837(3.441)	53.945 2.175)	44.354(1.588)	38.416(1.255)
2		30	106.952(3.870)	64.760(1.807)	49.493 1.159)	41.417(0.859)	36.227(0.669)
		50	99.401(3.047)	61.786(1.536)	47.849 1.013)	40.374(0.766)	35.551(0.609)
	0.5	10	118.564(6.300)	73.505(3.410)	55.213 2.247)	45.028(1.661)	38.700(1.313)
		30	107.865(3.538)	66.792(1.814)	50.940 1.201)	41.976(0.896)	36.206(0.710)
		50	99.533(2.780)	63.607(1.526)	48.690 1.031)	40.499(0.788)	35.252(0.630)
	0.1	10	117.480(6.502)	69.973(3.322)	53.087 2.169)	44.215(1.621)	38.453(1.270)
		30	103.275(4.338)	62.618(2.025)	48.197 1.293)	40.594(0.954)	35.549(0.754)
		50	99.853(2.776)	62.036(1.417)	48.359 0.966)	40.716(0.718)	35.827(0.575)
	0.2	10	116.019(6.176)	70.428(3.321)	53.157 2.212)	43.864(1.644)	37.927(1.295)
5		30	102.248(4.193)	62.762(2.035)	48.039(1.312)	40.127(0.964)	35.134(0.758)
		50	100.331(2.678)	62.253(1.400)	48.205(0.961)	40.422(0.721)	35.344(0.583)
	0.5	10	113.683(5.360)	72.823(3.156)	55.108(2.198)	45.588(1.667)	39.005(1.344)
		30	101.274(3.581)	65.091(1.967)	49.919(1.325)	41.385(0.987)	35.961(0.802)
		50	100.889(2.340)	65.149(1.358)	50.378(0.977)	42.000(0.736)	36.464(0.598)
	0.1	10	102.370(5.627)	61.678(2.597)	47.414(1.686)	39.821(1.252)	34.967(0.990)
		30	101.764(4.254)	61.118(2.007)	46.841(1.288)	39.565(0.968)	34.708(0.775)
		50	100.683(3.492)	60.440(1.648)	46.181(1.084)	39.435(0.800)	34.383(0.644)
	0.2	10	100.200(5.203)	61.725(2.545)	47.301(1.676)	39.401(1.265)	34.433(1.015)
10		30	99.830(3.955)	61.102(1.957)	47.055(1.300)	39.195(0.969)	34.253(0.777)
		50	99.997(3.227)	60.627(1.600)	47.083(1.058)	39.271(0.808)	34.237(0.652)
	0.5	10	99.673(4.304)	65.320(2.421)	50.370(1.653)	42.084(1.289)	36.508(1.013)
		30	98.903(3.265)	64.807(1.870)	50.096 1.281)	41.794(0.972)	36.422(0.794)
		50	100.516(2.556)	65.530(1.470)	50.380(1.025)	41.765(0.801)	36.142(0.645)

Table S.12: Actual ATS_0 (in the column labeled by $\delta = 0$) and ATS_1 values of the chart (14)-(15), along with their standard errors (in parentheses), for detecting step mean shift of the size δ occurring at the initial observation time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 10, 30$ or 50, the error terms of the process observations follow the AR(1) model (11) with $\phi = 0.8$, $k = 0.1, 0.2$ or 0.5, $d = 2, 5$ or 10, $\omega = 0.005$, and the nominal ATS_0 is 20.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
	0.1	10	25.355(1.425)	14.647(0.768)	9.521(0.413)	7.030(0.240)	5.689(0.147)
		30	21.070(0.708)	12.231(0.340)	8.261(0.173)	6.337(0.097)	5.280(0.059)
		50	21.153(0.547)	12.186(0.273)	8.229(0.142)	6.325(0.083)	5.299(0.052)
	0.2	10	25.383(1.400)	14.575(0.757)	9.566(0.421)	7.001(0.241)	5.658(0.144)
2		30	21.058(0.700)	12.260(0.344)	8.176(0.174)	6.270(0.095)	5.226(0.059)
		50	21.265(0.545)	12.178(0.274)	8.228(0.145)	6.278(0.084)	5.236(0.051)
	0.5	10	25.008(1.378)	14.522(0.743)	9.490(0.421)	6.915(0.242)	5.567(0.146)
		30	20.930(0.685)	12.124(0.335)	8.146(0.174)	6.151(0.097)	5.167(0.058)
		50	21.073(0.530)	12.125(0.277)	8.117(0.147)	6.162(0.081)	5.129(0.049)
	0.1	10	23.143(1.237)	12.862(0.696)	8.123(0.396)	5.689(0.228)	4.383(0.141)
		30	20.314(0.708)	11.284(0.364)	7.308(0.201)	5.310(0.118)	4.177(0.079)
		50	20.494(0.535)	11.246(0.279)	7.279(0.156)	5.254(0.096)	4.164(0.065)
	0.2	10	22.863(1.196)	12.720(0.686)	8.069(0.410)	5.591(0.233)	4.246(0.147)
5		30	20.106(0.696)	11.212(0.365)	7.177(0.203)	5.165(0.122)	4.034(0.079)
		50	20.428(0.531)	11.225(0.283)	7.175(0.162)	5.110(0.097)	4.027(0.065)
	0.5	10	22.234(1.101)	12.835(0.695)	8.082(0.429)	5.580(0.268)	4.139(0.163)
		30	20.052(0.647)	11.353(0.370)	7.219(0.215)	5.066(0.130)	3.869(0.082)
		50	20.246(0.508)	11.309(0.298)	7.234(0.178)	5.036(0.106)	3.867(0.067)
	0.1	10	23.084(1.090)	12.388(0.540)	7.654(0.297)	5.286(0.174)	4.005(0.114)
		30	21.701(0.702)	11.650(0.337)	7.327(0.170)	5.200(0.100)	4.003(0.063)
		50	20.753(0.566)	11.173(0.266)	7.086(0.140)	5.064(0.082)	3.908(0.054)
	0.2	10	22.357(1.039)	12.231(0.542)	7.500(0.297)	5.120(0.176)	3.815(0.115)
10		30	21.272(0.673)	11.559(0.330)	7.198(0.178)	5.022(0.105)	3.805(0.066)
		50	20.471(0.551)	11.052(0.268)	6.886(0.141)	4.861(0.083)	3.705(0.053)
	0.5	10	21.779(0.925)	12.457(0.529)	7.705(0.315)	5.136(0.197)	3.671(0.126)
		30	21.046(0.599)	11.926(0.331)	7.380(0.194)	5.001(0.117)	3.646(0.073)
		50	20.279(0.472)	11.433(0.266)	7.063(0.152)	4.821(0.095)	3.543(0.058)

Table S.13: Actual ATS_0 (in the column labeled by $\delta = 0$) and ATS_1 values of the chart (14)-(15), along with their standard errors (in parentheses), for detecting drifts considered in Figure S.9(d)-(f) occurring at the initial observation time point, in cases when $\mu(t)$, $\sigma_y^2(t)$ and ϕ are estimated from an IC data with m individuals, $m = 10, 30$ or 50, the error terms of the process observations follow the AR(1) model (11) with the true value of $\phi = 0.8$, $k = 0.1, 0.2$ or 0.5, $d = 2, 5$ or 10, $\omega = 0.005$, and the nominal ATS_0 is 20.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
2	0.1	10	25.477(1.443)	18.318(0.914)	14.475(0.627)	12.232(0.484)	10.714(0.391)
		30	21.040(0.710)	15.656(0.439)	12.729(0.302)	10.978(0.228)	9.769(0.180)
		50	21.259(0.554)	15.627(0.342)	12.752(0.247)	10.946(0.190)	9.735(0.153)
	0.2	10	25.203(1.412)	18.162(0.894)	14.398(0.631)	12.134(0.478)	10.671(0.392)
		30	20.896(0.690)	15.506(0.430)	12.635(0.302)	10.826(0.225)	9.600(0.177)
		50	21.030(0.537)	15.588(0.344)	12.582(0.244)	10.784(0.190)	9.649(0.149)
	0.5	10	25.044(1.361)	18.214(0.896)	14.470(0.630)	12.139(0.485)	10.618(0.393)
		30	21.028(0.683)	15.590(0.433)	12.720(0.304)	10.817(0.228)	9.599(0.178)
		50	20.961(0.522)	15.514(0.346)	12.617(0.247)	10.856(0.188)	9.559(0.151)
5	0.1	10	22.881(1.222)	16.734(0.820)	13.412(0.600)	11.426(0.464)	10.020(0.370)
		30	20.256(0.708)	14.978(0.453)	12.220(0.323)	10.515(0.259)	9.321(0.206)
		50	20.394(0.526)	14.742(0.341)	12.224(0.249)	10.529(0.193)	9.360(0.158)
	0.2	10	22.372(1.166)	16.485(0.801)	13.216(0.594)	11.186(0.463)	9.885(0.378)
		30	19.789(0.678)	14.774(0.447)	12.010(0.320)	10.354(0.253)	9.168(0.211)
		50	20.016(0.520)	14.741(0.335)	12.052(0.249)	10.339(0.196)	9.162(0.161)
	0.5	10	21.855(1.086)	16.371(0.778)	13.214(0.590)	11.217(0.468)	9.811(0.390)
		30	19.713(0.629)	14.899(0.438)	12.158(0.328)	10.397(0.261)	9.190(0.215)
		50	20.309(0.482)	14.884(0.336)	12.175(0.266)	10.377(0.202)	9.200(0.172)
10	0.1	10	22.581(1.068)	16.440(0.665)	13.197(0.477)	11.241(0.368)	9.962(0.305)
		30	21.197(0.695)	15.571(0.417)	12.697(0.297)	10.913(0.229)	9.709(0.185)
		50	20.371(0.555)	15.086(0.346)	12.296(0.241)	10.590(0.190)	9.421(0.155)
	0.2	10	21.838(1.009)	16.188(0.652)	13.016(0.474)	11.076(0.371)	9.763(0.304)
		30	20.756(0.655)	15.388(0.411)	12.561(0.291)	10.750(0.228)	9.516(0.189)
		50	19.892(0.525)	14.813(0.332)	12.092(0.242)	10.417(0.187)	9.233(0.153)
	0.5	10	21.479(0.918)	16.303(0.621)	13.241(0.472)	11.228(0.368)	9.891(0.312)
		30	20.669(0.581)	15.691(0.401)	12.811(0.295)	10.942(0.231)	9.664(0.187)
		50	19.958(0.478)	15.084(0.325)	12.385(0.242)	10.645(0.192)	9.421(0.160)

Table S.14: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the chart (8)-(9) with the control limit computed by the block bootstrap procedure, along with their standard errors (in parentheses), for detecting step mean shift of the size δ occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 20, 40$ or 60, $k = 0.1, 0.2$ or 0.5, $d = 2, 5$ or 10, $\omega = 0.001$, and the nominal ATS_0 is 100.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
2	0.1	20	108.059(1.267)	55.017(0.654)	33.149(0.330)	22.079(0.197)	15.743(0.135)
		40	103.360(0.965)	53.638(0.440)	32.977(0.251)	21.489(0.144)	15.302(0.096)
		60	100.359(0.859)	53.797(0.417)	32.674(0.229)	21.719(0.142)	15.576(0.089)
	0.2	20	109.275(1.277)	53.799(0.675)	32.009(0.372)	20.810(0.214)	14.464(0.138)
		40	105.226(0.978)	53.689(0.450)	31.894(0.251)	20.698(0.150)	14.372(0.094)
		60	99.486(0.820)	52.436(0.436)	31.442(0.226)	20.594(0.128)	14.352(0.093)
	0.5	20	107.258(1.280)	57.315(0.757)	34.335(0.453)	21.462(0.254)	14.124(0.172)
		40	97.693(0.928)	55.080(0.534)	32.924(0.307)	20.666(0.193)	13.650(0.112)
		60	100.333(0.810)	56.400(0.481)	33.658(0.286)	21.262(0.179)	13.932(0.114)
5	0.1	20	108.834(1.052)	45.920(0.417)	25.968(0.190)	16.762(0.107)	11.957(0.067)
		40	105.483(0.820)	45.199(0.307)	25.030(0.137)	16.333(0.079)	11.700(0.045)
		60	102.034(0.689)	44.876(0.277)	24.953(0.125)	16.326(0.072)	11.706(0.044)
	0.2	20	105.579(1.021)	44.329(0.440)	24.668(0.208)	15.438(0.112)	10.782(0.067)
		40	95.921(0.805)	43.533(0.317)	23.635(0.143)	14.938(0.078)	10.381(0.045)
		60	98.282(0.654)	43.214(0.276)	23.522(0.125)	14.844(0.070)	10.393(0.043)
	0.5	20	103.165(1.122)	48.542(0.568)	26.205(0.281)	15.395(0.141)	9.973(0.079)
		40	99.054(0.761)	48.509(0.387)	25.953(0.205)	15.314(0.114)	9.961(0.058)
		60	99.044(0.696)	48.001(0.351)	25.776(0.180)	15.233(0.091)	9.872(0.055)
10	0.1	20	93.307(1.102)	36.075(0.351)	19.272(0.137)	12.660(0.068)	9.258(0.042)
		40	97.712(0.696)	36.975(0.226)	19.602(0.089)	12.725(0.044)	9.236(0.027)
		60	98.565(0.705)	37.302(0.238)	19.775(0.088)	12.747(0.045)	9.251(0.029)
	0.2	20	106.030(1.145)	39.705(0.403)	19.715(0.153)	12.128(0.073)	8.525(0.044)
		40	102.104(0.741)	38.771(0.259)	19.551(0.105)	12.122(0.050)	8.479(0.029)
		60	100.332(0.751)	39.021(0.265)	19.651(0.102)	12.182(0.050)	8.489(0.029)
	0.5	20	103.703(1.073)	43.151(0.470)	21.928(0.208)	12.128(0.104)	7.932(0.056)
		40	99.502(0.732)	42.934(0.330)	21.261(0.141)	12.094(0.069)	7.766(0.035)
		60	100.532(0.752)	43.024(0.314)	21.455(0.139)	12.109(0.062)	7.806(0.040)

Table S.15: Actual ATS_0 (in the column labelled by $\delta = 0$) and ATS_1 values of the chart (8)-(9) with the control limit computed by the block bootstrap procedure, along with their standard errors (in parentheses), for detecting drifts occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 20, 40$ or 60, $k = 0.1, 0.2$ or 0.5, $d = 2, 5$ or 10, $\omega = 0.001$, and the nominal ATS_0 is 100.

d	k	m	$\delta = 0$	$\delta = 0.25$	$\delta = 0.5$	$\delta = 0.75$	$\delta = 1.0$
2	0.1	20	108.158(1.189)	77.572(0.789)	63.827(0.610)	54.837(0.481)	48.912(0.391)
		40	103.864(0.887)	74.714(0.578)	61.609(0.432)	53.480(0.355)	47.613(0.294)
		60	100.178(0.836)	75.979(0.541)	62.538(0.383)	54.098(0.319)	48.487(0.257)
	0.2	20	107.666(1.225)	75.416(0.805)	62.138(0.601)	53.760(0.498)	47.697(0.389)
		40	94.625(0.821)	72.847(0.585)	60.164(0.436)	52.149(0.364)	46.322(0.297)
		60	98.995(0.759)	74.329(0.536)	61.328(0.406)	52.921(0.319)	47.245(0.279)
	0.5	20	105.487(1.231)	78.620(0.901)	64.787(0.658)	55.792(0.555)	49.375(0.457)
		40	97.897(0.937)	75.992(0.710)	62.741(0.517)	54.204(0.419)	48.039(0.353)
		60	99.708(0.817)	77.540(0.623)	64.397(0.461)	55.722(0.356)	49.254(0.288)
5	0.1	20	108.573(1.072)	72.410(0.633)	58.279(0.434)	49.932(0.327)	44.351(0.267)
		40	105.834(0.780)	71.746(0.431)	57.442(0.300)	49.176(0.243)	43.464(0.191)
		60	102.287(0.707)	71.222(0.413)	57.226(0.276)	48.979(0.221)	43.302(0.189)
	0.2	20	105.866(1.007)	69.704(0.628)	56.333(0.467)	48.245(0.343)	42.792(0.280)
		40	95.963(0.743)	68.764(0.460)	55.659(0.317)	47.476(0.246)	41.977(0.198)
		60	98.216(0.671)	68.991(0.404)	55.855(0.276)	47.657(0.220)	41.654(0.180)
	0.5	20	103.204(1.086)	73.390(0.717)	59.209(0.538)	50.391(0.394)	44.281(0.345)
		40	99.256(0.828)	73.155(0.515)	58.954(0.365)	50.288(0.279)	44.239(0.249)
		60	98.491(0.706)	72.481(0.452)	58.649(0.307)	50.049(0.259)	43.976(0.214)
10	0.1	20	93.003(1.080)	64.591(0.570)	51.530(0.365)	43.772(0.298)	38.785(0.244)
		40	97.148(0.705)	65.040(0.361)	51.764(0.255)	43.861(0.187)	38.892(0.159)
		60	98.949(0.780)	65.368(0.382)	51.927(0.252)	44.118(0.191)	38.944(0.152)
	0.2	20	105.098(1.138)	68.749(0.614)	53.581(0.420)	44.961(0.306)	39.281(0.254)
		40	101.850(0.780)	68.084(0.422)	53.336(0.268)	44.829(0.203)	39.395(0.171)
		60	100.185(0.729)	68.232(0.422)	53.676(0.281)	45.188(0.202)	39.570(0.168)
	0.5	20	102.731(1.102)	70.977(0.686)	56.296(0.502)	47.265(0.354)	41.287(0.305)
		40	99.749(0.715)	70.140(0.440)	55.831(0.325)	47.207(0.260)	41.171(0.195)
		60	100.410(0.725)	70.669(0.458)	55.941(0.324)	47.076(0.240)	41.364(0.196)

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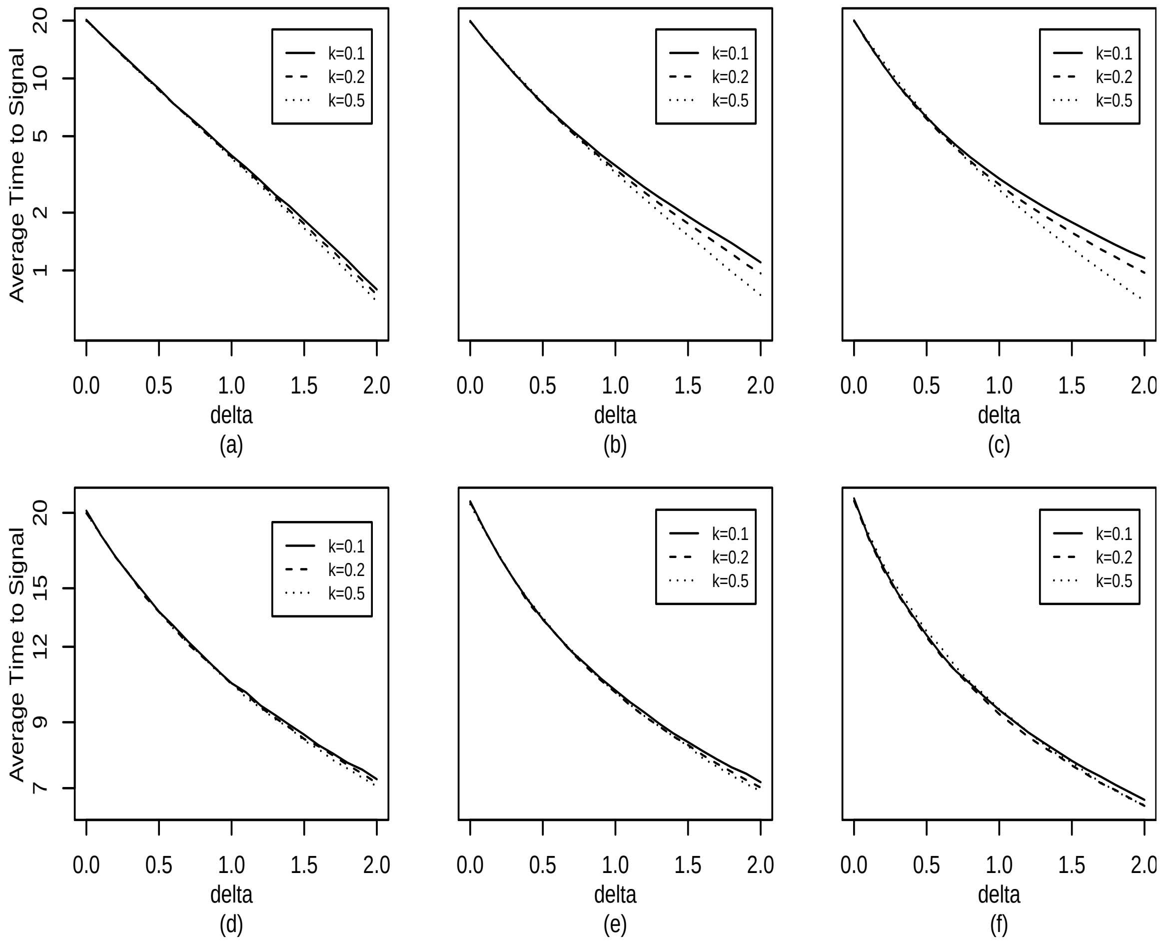

Figure S.1: (a)-(c) ATS_1 values of the chart (8)-(9) in cases when the IC process mean function $\mu(t)$ and the process variance function $\sigma_y^2(t)$ are assumed known, $k = 0.1, 0.2, 0.5$, ATS_0=20, step shift size δ changes its value from 0 to 2 with a step of 0.1, and the sampling rate $d = 2$ (plot (a)), $d = 5$ (plot (b)), and $d = 10$ (plot (c)). (d)-(f) Corresponding results when the mean shift is a nonlinear drift from $\mu(t)$ to $\mu_1(t) = \mu(t) + \delta(1 - \exp(-10t))$, for $t \in [0, 1]$. The y-axes of all plots are in natural log scale.

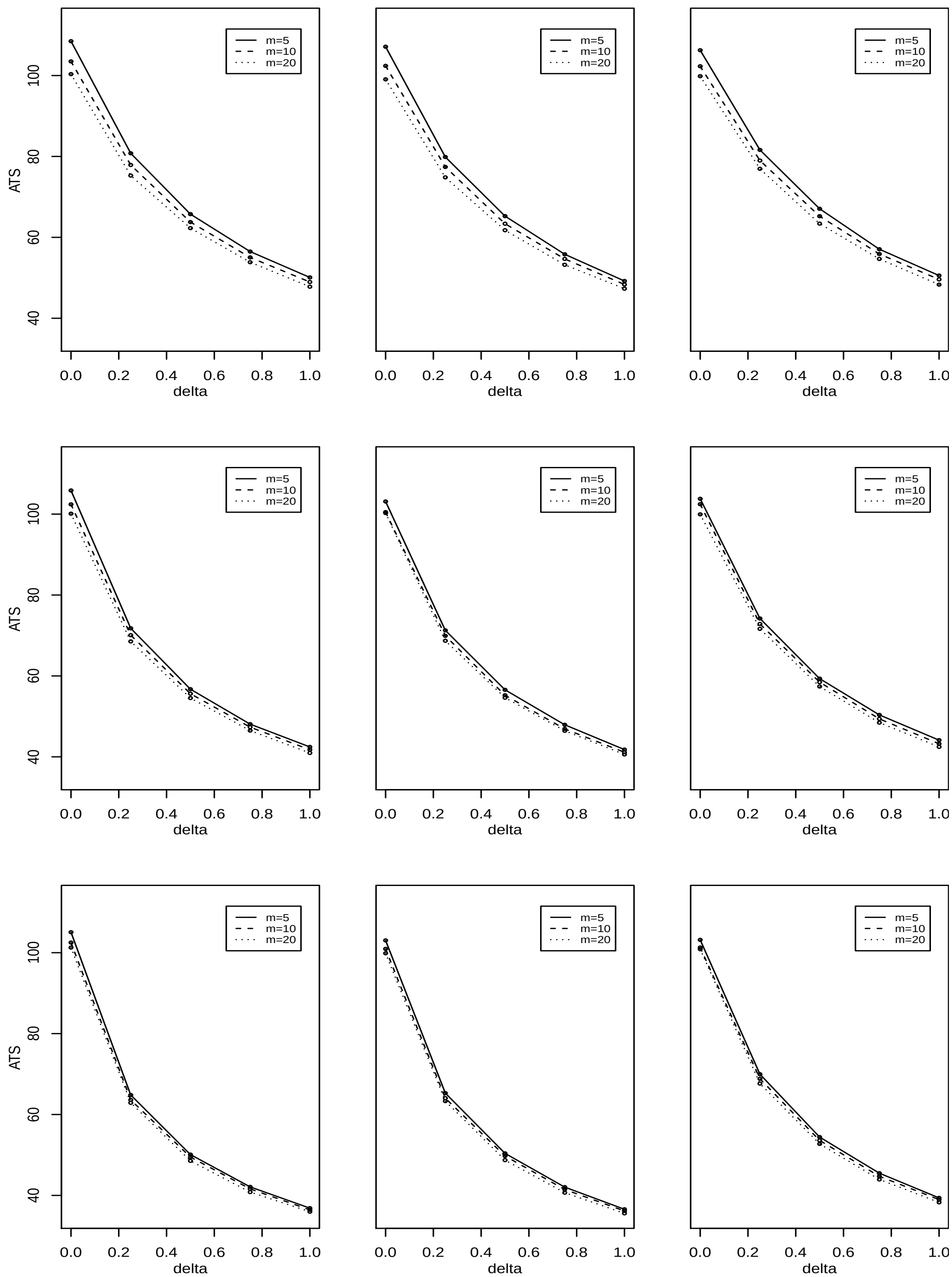

Figure S.2: Actual ATS_0 and ATS_1 values of the chart (8)-(9), for detecting drifts occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $k = 0.1$ (1st column), 0.2 (2nd column) or 0.5 (3rd column), $d = 2$ (1st row), 5 (2nd row) or 10 (3rd row), $\omega = 0.001$, and the nominal ATS_0 is 100.

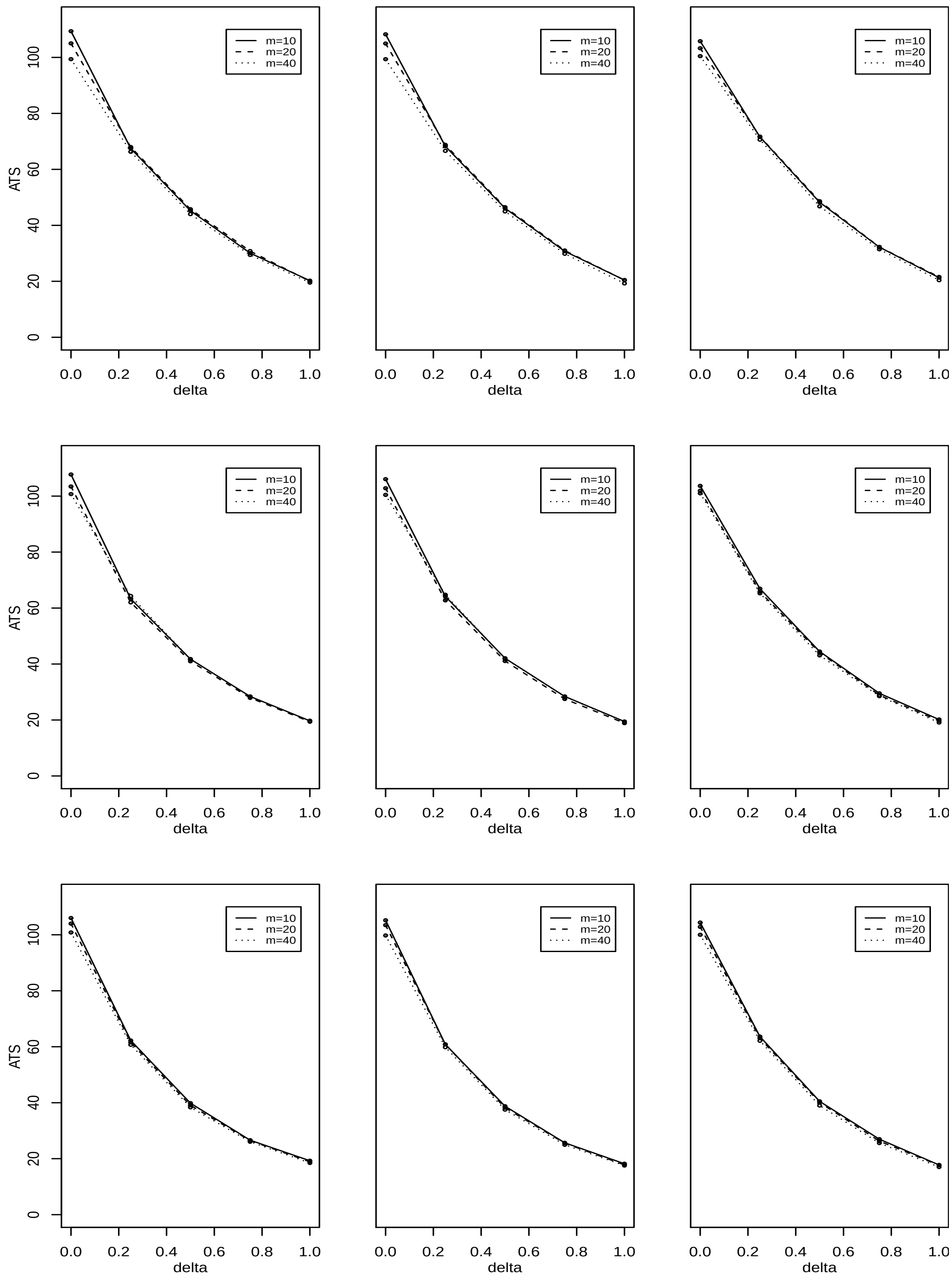

Figure S.3: Actual ATS_0 and ATS_1 values of the chart (8)-(9), for detecting step mean shift of the size δ occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 10, 20$ or 40, $k = 0.1$ (1st column), 0.2 (2nd column) or 0.5 (3rd column), $d = 0.2$ (1st row), 0.5 (2nd row) or 1 (3rd row), $\omega = 0.001$, and the nominal ATS_0 is 100.

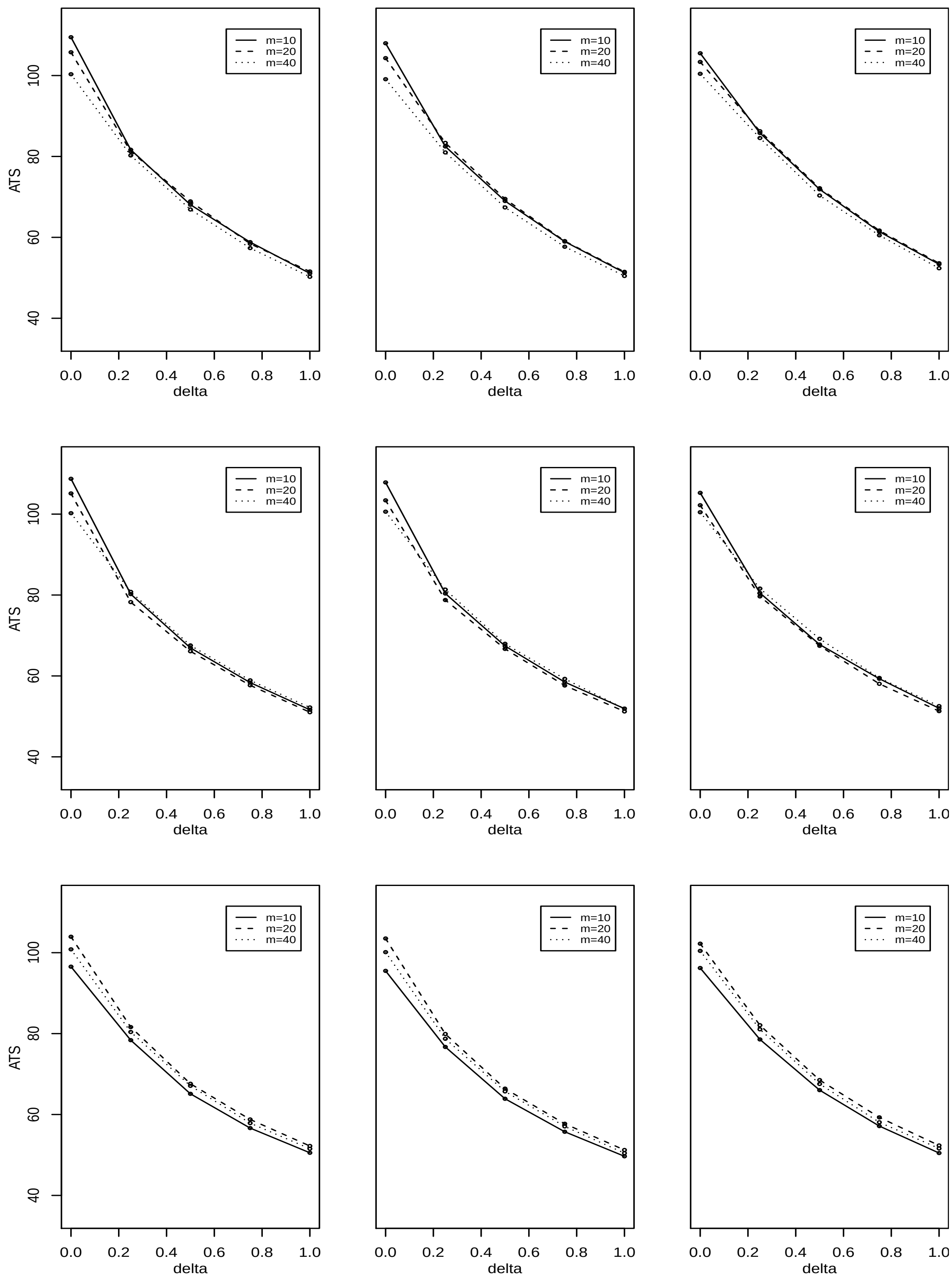

Figure S.4: Actual ATS_0 and ATS_1 values of the chart (8)-(9) for detecting drifts occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 10, 20$ or 40, $k = 0.1$ (1st column), 0.2 (2nd column) or 0.5 (3rd column), $d = 0.2$ (1st row), 0.5 (2nd row) or 1 (3rd row), $\omega = 0.001$, and the nominal ATS_0 is 100.

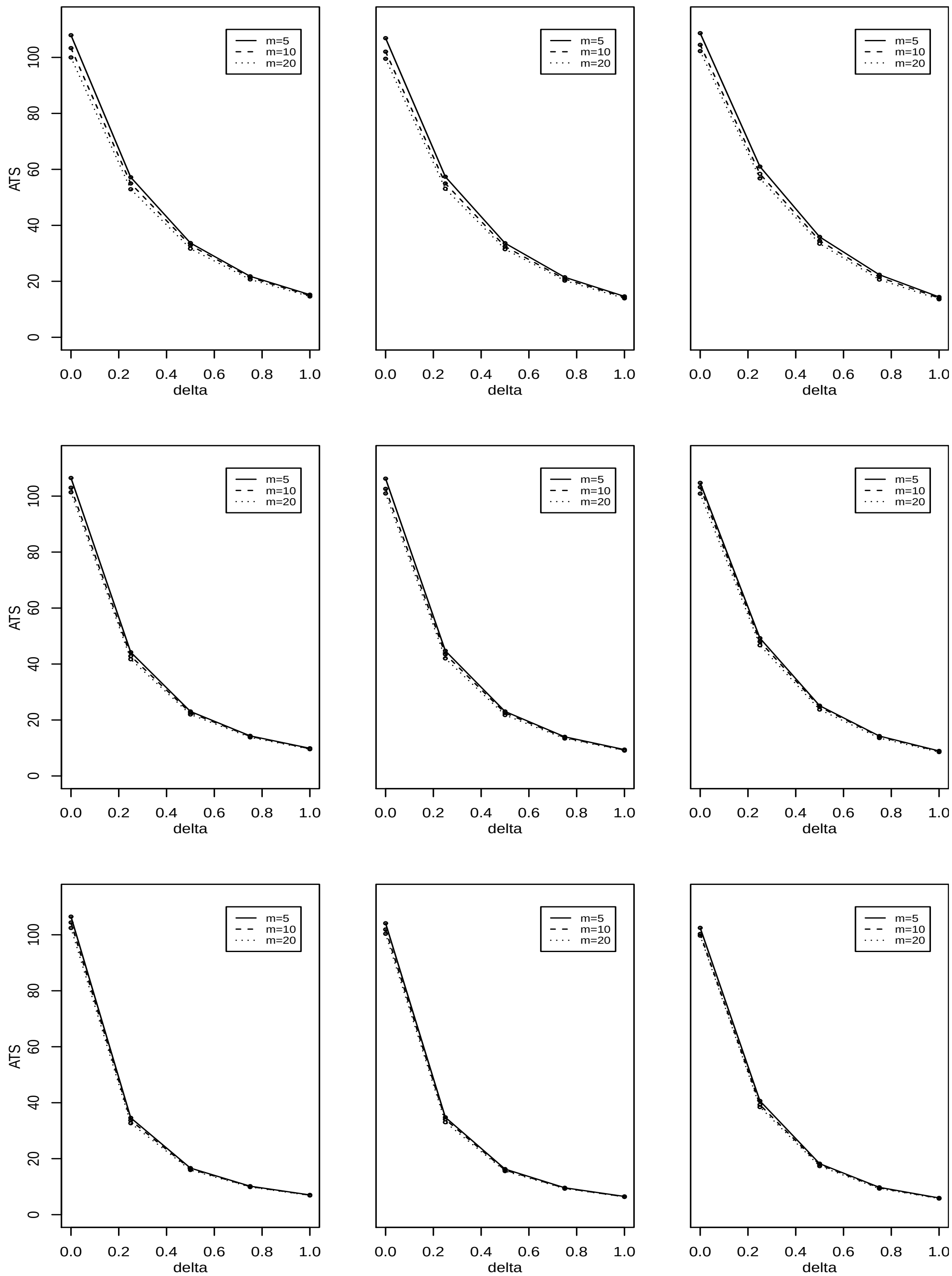

Figure S.5: Actual ATS_0 and ATS_1 values of the adaptive CUSUM chart proposed by Shu and Jiang (2006), for detecting step mean shift of the size δ occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $\delta_{min} = 0.2$ (1st column), 0.4 (2nd column) or 1.0 (3rd column), $d = 2$ (1st row), 5 (2nd row) or 10 (3rd row), $\omega = 0.001$, and the nominal ATS_0 is 100.

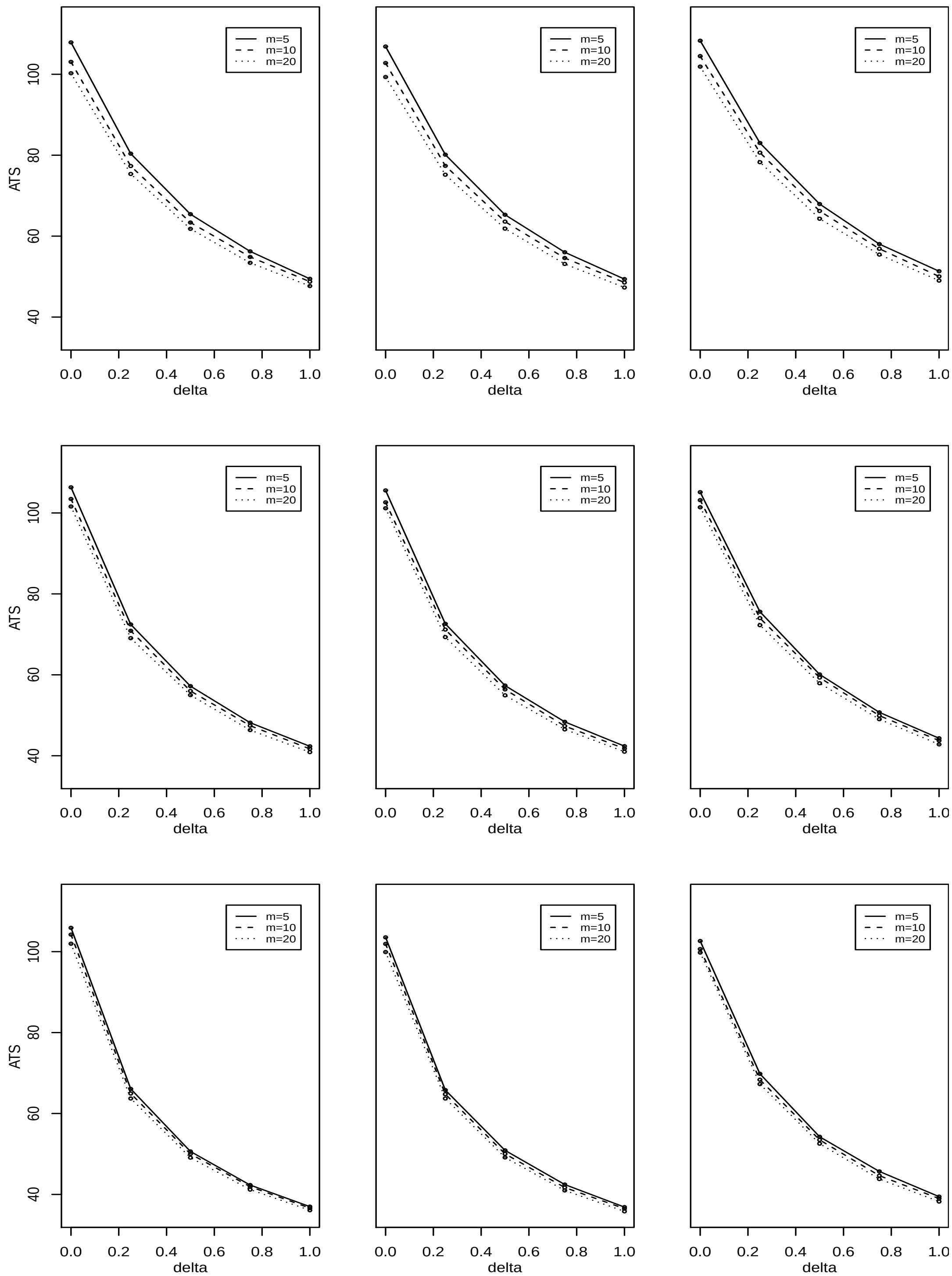

Figure S.6: Actual ATS_0 and ATS_1 values of the adaptive CUSUM chart proposed by Shu and Jiang (2006), for detecting drifts occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $\delta_{min} = 0.2$ (1st column), 0.4 (2nd column) or 1.0 (3rd column), $d = 2$ (1st row), 5 (2nd row) or 10 (3rd row), $\omega = 0.001$, and the nominal ATS_0 is 100.

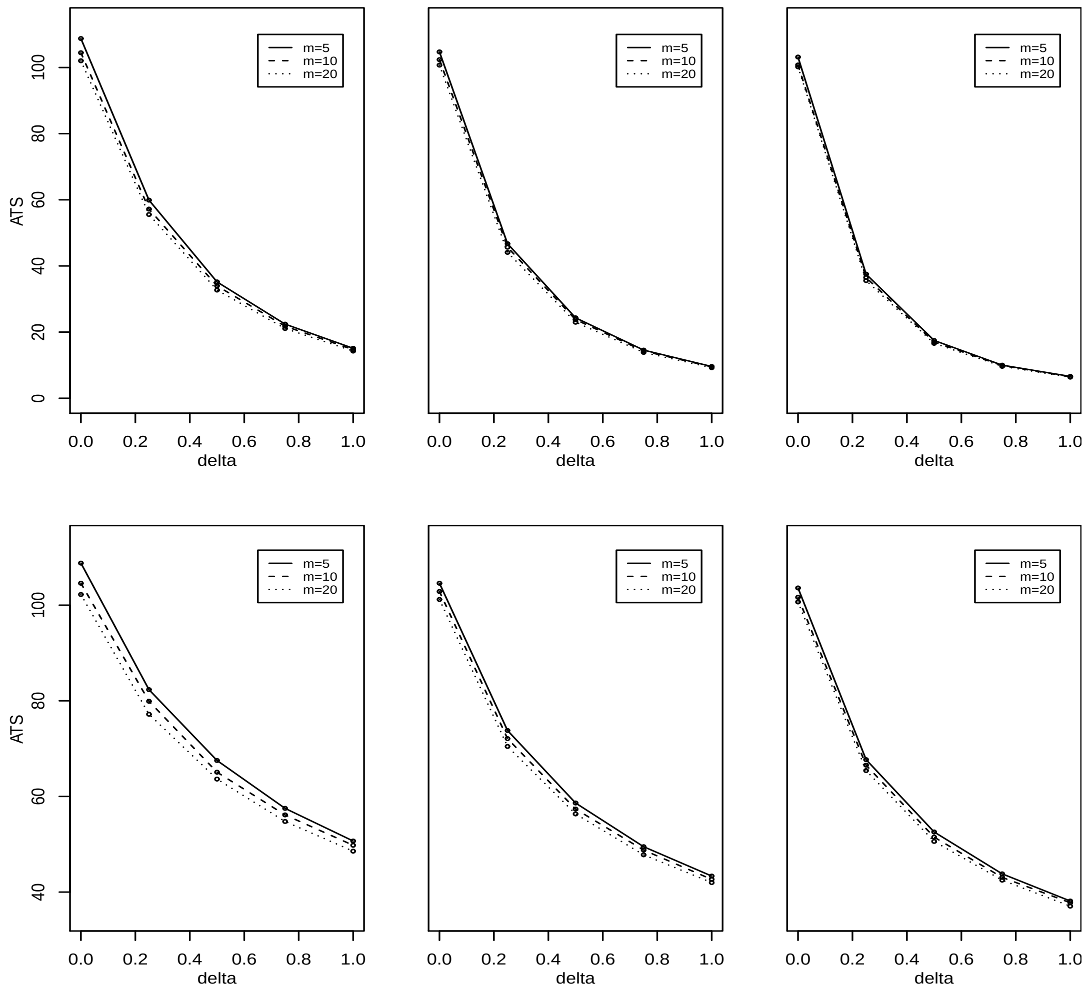

Figure S.7: Actual ATS_0 and ATS_1 values of the RFCuscore chart proposed by Han and Tsung (2006), for detecting step shifts or drifts occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 5, 10$ or 20, $\omega = 0.001$, and the nominal ATS_0 is 100. The three plots in first row show the results for detecting step shifts when d is 2, 5, and 10, respectively. The three plots in second row show the corresponding results for detecting drifts.

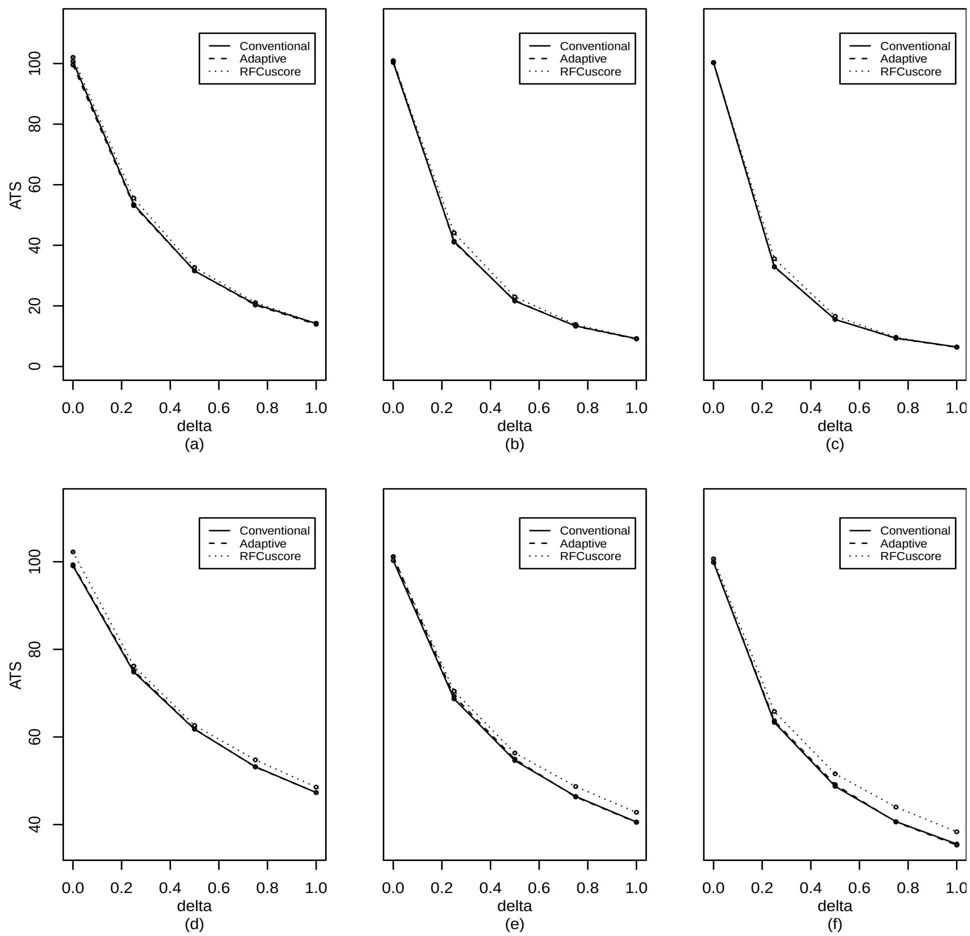

Figure S.8: ATS_0 and ATS_1 values of the conventional CUSUM chart (8)-(9), the adaptive CUSUM by Shu and Jiang (2006) and the RFCuscore chart by Han and Tsung (2006) in the example of Figures 2 and S.2 when $m = 20$, $d = 2$ ((a) and (d)), 5 ((b) and (e)), and 10 ((c) and (f)), $k = 0.2$ in the chart (8)-(9), and $\delta^+_{min} = 0.4$ in the adaptive CUSUM chart. The results shown in plots (a)-(c) are for detecting step shifts and the ones shown in plots (d)-(f) are for detecting drifts.

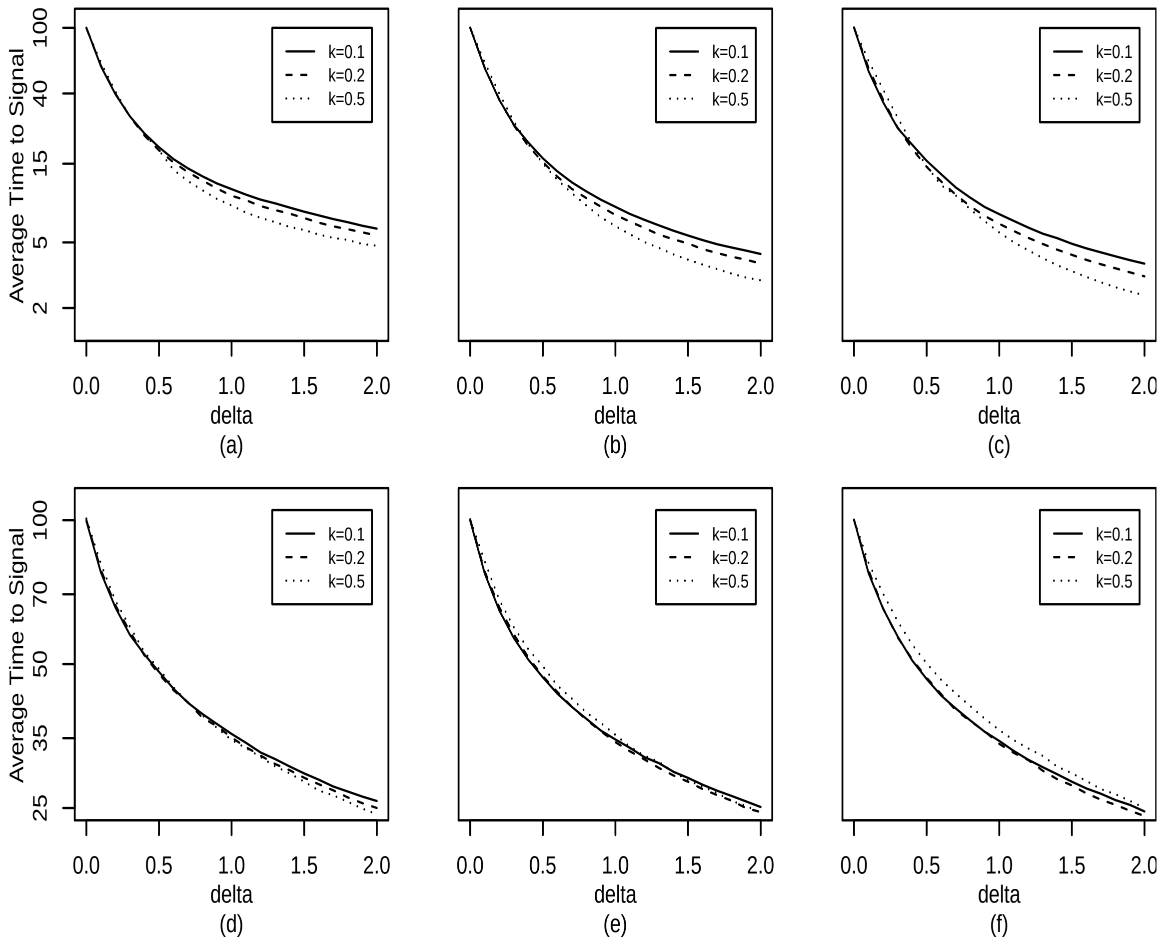

Figure S.9: (a) ATS_1 values of the chart (14)-(15) in cases when the IC process mean function $\mu(t)$ and the process variance function $\sigma_y^2(t)$ are assumed known, the error terms of process observations follow the AR(1) model (11) with $\phi = 0.8$, $k = 0.1, 0.2, 0.5$, ATS_0=100, step shift size δ changes its value from 0 to 2 with a step of 0.1, and the sampling rate $d = 2$ (plot (a)), $d = 5$ (plot (b)), and $d = 10$ (plot (c)). (d)-(f) Corresponding results when the mean shift is a nonlinear drift from $\mu(t)$ to $\mu_1(t) = \mu(t) + \delta(1 - \exp(-10t))$, for $t \in [0, 1]$. The y-axes of all plots are in natural log scale.

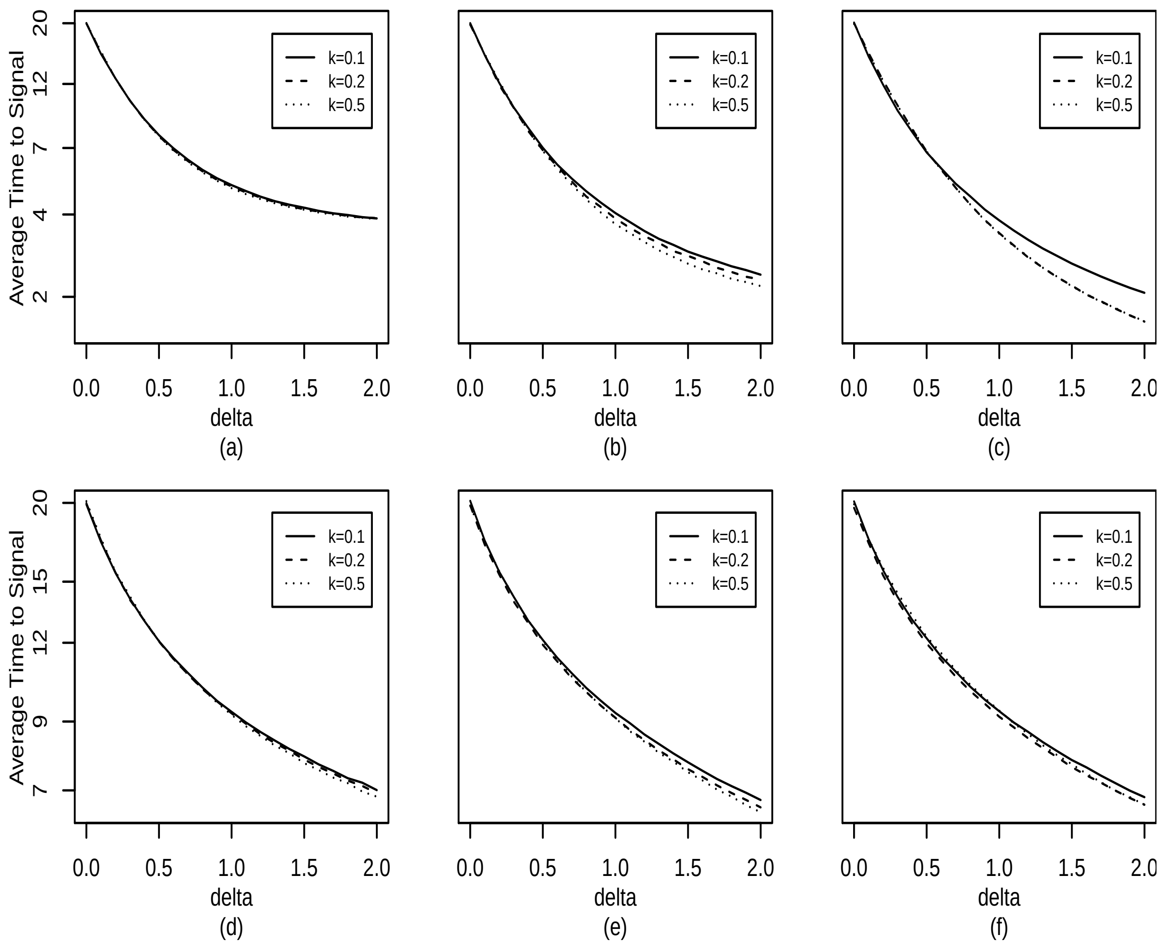

Figure S.10: (a)-(c) ATS_1 values of the chart (14)-(15) in cases when the IC process mean function $\mu(t)$ and the process variance function $\sigma_y^2(t)$ are assumed known, the error terms of process observations follow the AR(1) model (11) with $\phi = 0.8$, $k = 0.1, 0.2, 0.5$, ATS_0=20, step shift size δ changes its value from 0 to 2 with a step of 0.1, and the sampling rate $d = 2$ (plot (a)), $d = 5$ (plot (b)), and $d = 10$ (plot (c)). (d)-(f) Corresponding results when the mean shift is a nonlinear drift from $\mu(t)$ to $\mu_1(t) = \mu(t) + \delta(1 - \exp(-10t))$, for $t \in [0, 1]$. The y-axes of all plots are in natural log scale.

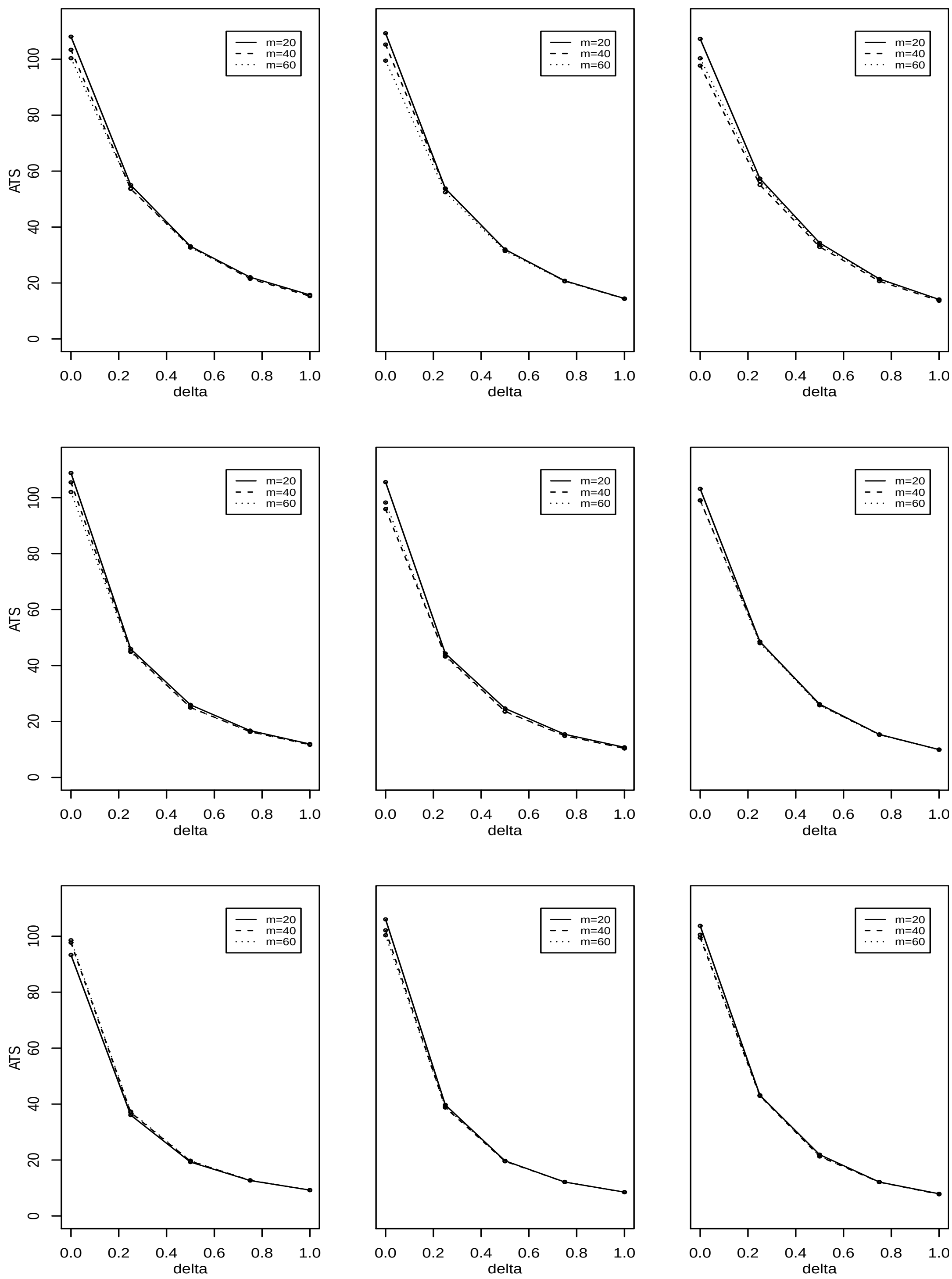

Figure S.11: Actual ATS_0 and ATS_1 values of the chart (8)-(9) with the control limit computed by the block bootstrap procedure, for detecting step mean shift of the size δ occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 20, 40$ or 60, $k = 0.1$ (1st column), 0.2 (2nd column) or 0.5 (3rd column), $d = 2$ (1st row), 5 (2nd row) or 10 (3rd row), $\omega = 0.001$, and the nominal ATS_0 is 100.

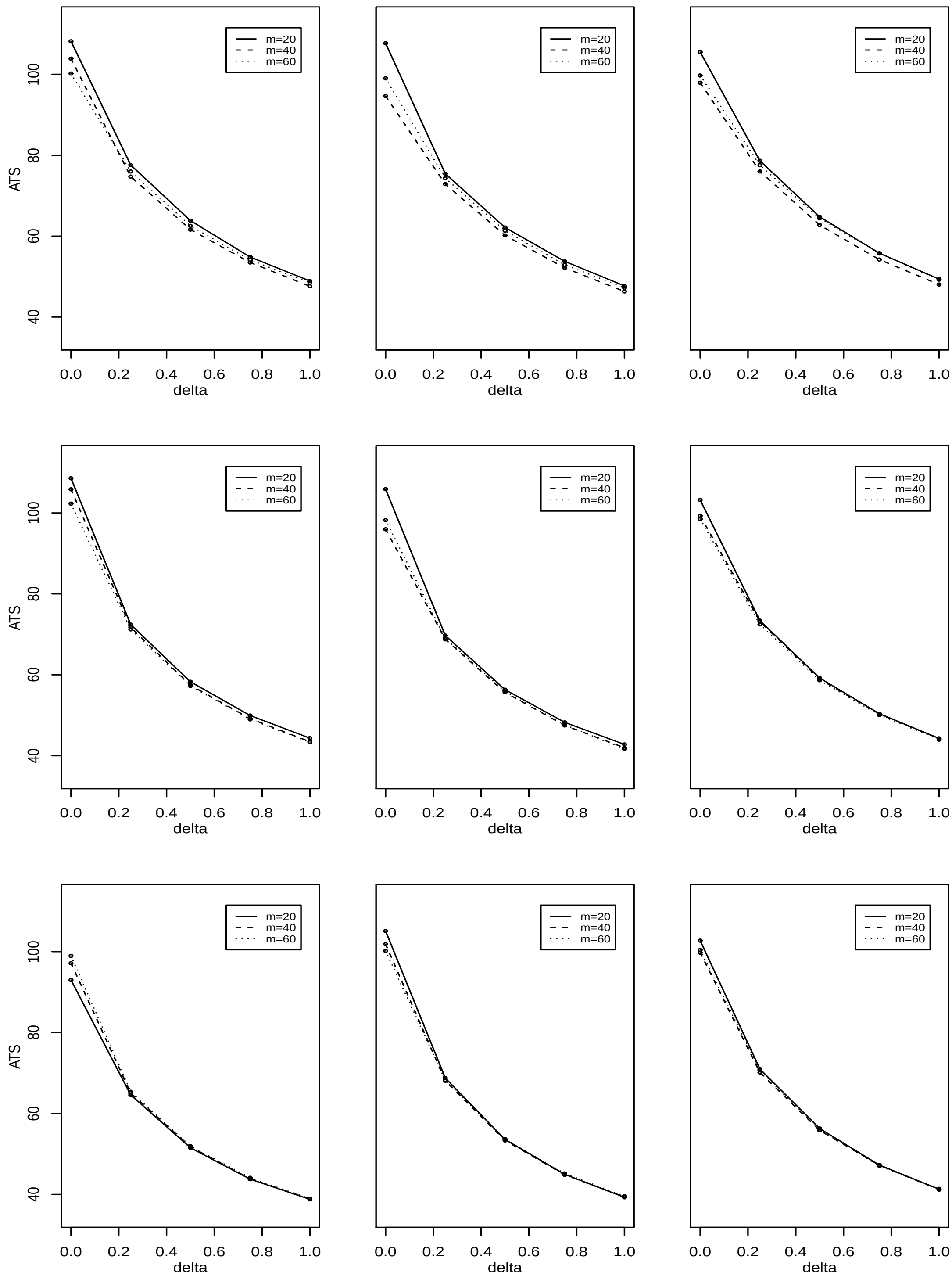

Figure S.12: Actual ATS_0 and ATS_1 values of the chart (8)-(9) with the control limit computed by the block bootstrap procedure, for detecting drifts occurring at the initial time point, in cases when the IC mean function $\mu(t)$ and the IC variance function $\sigma_y^2(t)$ are estimated from an IC data with m individuals, $m = 20, 40$ or 60, $k = 0.1$ (1st column), 0.2 (2nd column) or 0.5 (3rd column), $d = 2$ (1st row), 5 (2nd row) or 10 (3rd row), $\omega = 0.001$, and the nominal ATS_0 is 100.