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標本調査法の記号について

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標本調査法ではその内容の性格上他の分野に比べてかなり多くの記号を定義する必要がある．その発達当初から各著者は記号の選定に苦労したことがそれぞれの著書をみると窺える．特異な例として Yates [17] は活字の型を変える方法を用い，一時期幾つかの論文にも利用されたが，現在は殆ど使われていない．本来数学的記号の定義は自由であると云っても，一般には不文律的に統一されているものが多い．しかし標本調査法では不統一が甚だしい．例えば x_k を確率変数とする書物もあれば母数とするものもある等である．論文の場合は，本来全文を通読すべきものであるから，自由な定義があっても差支ないが，成書の場合は，部分的利用のためにも，初心者の混乱を防ぐ意味からも，是非とも統一した記号を採用して欲しいものである．この意味から，筆者が過去に通読した成書を比較検討し，一方一般数理統計学の常識からも

逸脱しないことを念頭に，標本調査法の記号統一の素案を作ってみた．それらは必ずしも頻度の高いものとも限らず，記号のもつ意味から決めたものもある．比較検討した書物の主なものを文献欄に示した（他の数種および邦書は割愛した）．以下の記号表には参考として有名または最近の成書（文献番号に*を付したもの）にある記号も示した．なお，記号統一を詳細に過ぎるとかえって弊害もありうるので，基本的なもの，主要抽出方法，に限定した．最後にJISのような意味での統一を企てる意志のないことを付記しておく．

	Proposed		[1] Cochran		[4] Deming		[5] Hansen ...		[9] Konijn		[10] Murthy		[11] Sukhatme	
[General]														
Expectation	$E[\hat\theta]$		$E(\hat\theta)$		$E\hat\theta$		$E\hat\theta$		$\mathcal{E}\hat\theta$		$E(\hat\theta)$		$E(\hat\theta)$	
Variance	$V[\hat\theta]$	$v[\hat\theta]$	$V(\hat\theta)$	$v(\hat\theta)$	$Var\,\hat\theta$	$\hat{Var}\,\hat\theta$	$\sigma^2_{\hat\theta}$	$s^2_{\hat\theta}$	$V(\hat\theta)$	-	$V(\hat\theta)$	$v(\hat\theta)$	$V(\hat\theta)$	$Est.V(\hat\theta)$
Standard error	$D[\hat\theta]$	$d[\hat\theta]$	$\sigma_{\hat\theta}$	$s_{\hat\theta}$	$\sigma_{\hat\theta}$		$\sigma_{\hat\theta}$	$s_{\hat\theta}$	-	-	$\sigma(\hat\theta)$	$s(\hat\theta)$	$S.E.(\hat\theta)$	$Est.S.E.(\hat\theta)$
Coef. of variation	$CV[\hat\theta]$	$cv[\hat\theta]$	C.V.		$C_{\hat\theta}$	$\hat{C}_{\hat\theta}$	$V_{\hat\theta}$	$v_{\hat\theta}$	$CV(\hat\theta)$	-	$C(\hat\theta)$	$c(\hat\theta)$	-	-
Bias	$B[\hat\theta]$	$b[\hat\theta]$	bias in $\hat\theta$	-	$B\hat\theta$	-	-	-	-	-	$B(\hat\theta)$	$b(\hat\theta)$	bias in $\hat\theta$	
Mean square error	$MSE[\hat\theta]$	$mse[\hat\theta]$	$MSE(\hat\theta)$	$mse(\hat\theta)$	$\{M\hat\theta\}^2$	-	$MSE_{\hat\theta}$	-	-	-	$M(\hat\theta)$	$m(\hat\theta)$	$M.S.E.(\hat\theta)$	
Covariance	$Cov[\hat\theta,\hat\theta']$	$cov[\hat\theta,\hat\theta']$	$Cov(\hat\theta\hat\theta')$	$cov(\hat\theta\hat\theta')$	$Cov\,\hat\theta,\hat\theta'$	-	$S_{\hat\theta\hat\theta'}$	$s_{\hat\theta\hat\theta'}$	$\sigma(\hat\theta\hat\theta')$	-	$Cov(\hat\theta,\hat\theta')$	$cov(\hat\theta,\hat\theta')$	$Cov(\hat\theta,\hat\theta')$	
Correlation coef.	$\rho[\hat\theta,\hat\theta']$	$r[\hat\theta,\hat\theta']$	$\rho_{\hat\theta\hat\theta'}$		$\rho_{\hat\theta\hat\theta'}$		$\rho_{\hat\theta\hat\theta'}$	$\rho'_{\hat\theta\hat\theta'}$	$\rho(\hat\theta\hat\theta')$	-	ρ	$\hat\rho'$		
Summation	$\sum_{i=1}^{N} a_i$	$\sum_{i=1}^{n} x_i$	$\sum_{i=1}^{N} y_i$	$\sum_{i=1}^{n} y_i$	$\sum_{1}^{N} a_i$	$\sum_{1}^{n} x_i$	$\sum^{N} X_i$	$\sum^{n} x_i$	$\sum_{i=1}^{N} y_i$	$\sum_{i=1}^{N} a_i y_i$	$\sum_{i=1}^{N}$	$\sum_{i=1}^{n}$	$\sum^{N}$	$\sum^{n}$
Conditional E & V	$V[\hat\theta] = \underset{1}{E}\underset{2}{V}[\hat\theta] + \underset{1}{V}\underset{2}{E}[\hat\theta]$		-				$E\sigma^2_{\hat\theta\|[1]} + \sigma^2_{E(\hat\theta\|[1])}$		$\mathcal{E}\{V(\hat\theta\|\mathcal{T})\}+V\{\mathcal{E}(\hat\theta\|\mathcal{T})\}$		$\underset{1}{E}\underset{2}{V}(\hat\theta) + \underset{1}{V}\underset{2}{E}(\hat\theta)$		$EV(\hat\theta\|n)+VE\hat\theta\|n)$	
[Simple Random Samp.]														
No. of s. units	N	n	N	n	N	n	N	n	N	n	N	n	N	n
Variate	a_i	x_i	y_i	y_i	a_i	x_i	X_i	x_i	y_i	$a_i y_i$	Y_i	y_i	y_i	y_i $\alpha_i y_i$
Mean	$\bar a$	$\bar x$	$\bar Y$	$\bar y$ or $\hat{\bar Y}$	$\bar a$	$\bar x$	$\bar X$	$\bar x$	$\bar Y$	$\bar y$	$\bar Y$	$\bar y$	$\bar y_N$	$\bar y_n$
Total	A	X	Y	$\hat Y$	A	X	X	x'	$N\bar Y$	$N\bar y$	Y	$\hat Y$	$N\bar y_N$	$N\bar y_n$
Variance (para.)	$\sigma^2=\frac{1}{N}\sum(a_i-\bar a)^2$		σ^2		σ^2	s^2	σ^2		σ^2		σ^2			
"	$S^2=\frac{1}{N-1}\sum(a_i-\bar a)^2$	$s^2=\frac{1}{n-1}\sum(x_i-\bar x)^2$	S^2	s^2	-	$\hat\sigma^2$	S^2	s^2	S^2	s^2	σ'^2	s^2	S^2	s^2
C.V. (parameter)	γ	c	C.V.	-	C_x	-	V	v	-	-	C_y	-	C_y	
Proportion	P, Q	p, q	P, Q	p, q	p, q	$\hat p$, $\hat q$	P, Q	p, q	P, Q	p, q	P, Q	p, q	p, q	p_n, q_n
Sampling fraction	f		f		n/N		f		f		f		n/N	
Sampling interval	d		k		N/n		k		k		k		K	

	Proposed		[1] Cochran		[4] Deming		[5] Hansen ...		[9] Konijn		[10] Murthy		[11] Sukhatme	
[Ratio & Regression]														
Variates	a_i , b_i	x_i , y_i	y_i , x_i	y_i , x_i	a_i , b_i	x_i , y_i	X_i , Y_i	x_i , y_i	y_i , x_i	y_i , x_i	Y_i , X_i	y_i , x_i	y_i , x_i	y_i , x_i
Mean	$\bar{a} , \bar{b}$	$\bar{x} , \bar{y}$	$\bar{Y} , \bar{X}$	$\bar{y} , \bar{x}$	$\bar{a} , \bar{b}$	$\bar{x} , \bar{y}$	$\bar{X} , \bar{Y}$	$\bar{x} , \bar{y}$	$\bar{Y} , \bar{X}$	$\bar{y} , \bar{x}$	$\bar{Y} , \bar{X}$	$\bar{y} , \bar{x}$	$\bar{y}_N , \bar{x}_N$	$\bar{y}_n , \bar{x}_n$
Total	A , B	X , Y	Y , X	$\hat{Y} , \hat{X}$	A , B	X , Y	X , Y	x' , y'	Y , X	$\hat{Y} , \hat{X}$	Y , X	$\hat{Y} , \hat{X}$	Y , X	
Ratio	$R = A/B$	$\hat{R} = X/Y$	R	$\hat{R}$	ϕ	f	R	r	R	$\hat{R}$	R	$\hat{R}$	R_N	R_n
Mean in subclass	$\bar{a}_D$	$\bar{x}_D$	$\bar{Y}_j$	$\bar{y}_j$	-	-	$\bar{X}_g$	$\bar{x}_g$	$\bar{Y}_1$	$\bar{y}_1$	$\bar{Y}'$	$\bar{y}''$	-	-
Variance	$\sigma^2(x)$		-		σ_x^2	s_x^2	σ_X^2		$\sigma^2(y)$		σ_y^2		-	
"	$S^2(x)$	$s^2(x)$	S_y^2	s_y^2	-	$\hat{\sigma}_x^2$	S_X^2	s_X^2	$S^2(y)$	$s^2(y)$	$\sigma_y'^2$	s_y^2	S_y^2	s_y^2
C.V.	$\gamma(x)$	$c(x)$	C_{yy}		C_x	$\hat{C}_x$	V_X	v_X	$C(yy)$	-	C_y	-	C_y	c_y
Covariance	$\sigma(x,y)$	$s(x,y)$	S_{yx}	s_{yx}	-		S_{XY}	s_{XY}	$S(yx)$	-	σ_{yx}	s_{yx}	S_{yx}	s_{yx}
Rel-covariance	$\gamma(x,y)$	$c(x,y)$	C_{yx}		C_{xy}	$\hat{C}_{xy}$	V_{XY}	v_{XY}	$C(yx)$	-	C_{yx}	—	C_{yx}	c_{yx}
Correlation coef.	ρ or $\rho(x,y)$	r or $r(x,y)$	ρ	-	ρ	-	ρ	ρ'	$\rho(yx)$	-				
Var. of differ.	$S^2(R)=\frac{1}{N-1}\sum(a_i-Rb_i)^2$	$s^2(R)=\frac{1}{n-1}\sum(x_i-\hat{R}y_i)^2$	S_d^2	s_d^2			S_Z^2	s_Z^2	$S^2(D)$	$s^2(D)$	-	-	-	-
Size of subclass	N_D	n_D	N_j	n_j			N_g	n_g	N_1	n_1	-	-	-	-
Var. in subclass	S_D^2	s_D^2	S'^2	s'^2			S_g^2	s_g^2	S_1^2	s_1^2	σ''^2	s''^2	-	-
Ratio est. (mean)		$\bar{x}_R$		$\hat{\bar{Y}}_R$		$\bar{x}'$		-		$\hat{\bar{Y}}_R$		$\bar{y}_R$		$\bar{y}_R$
" " (total)		X_R		$\hat{Y}_R$		X'		x''				$\hat{Y}_R$		—
Regres. est. (total)		X_{LR}		$\hat{Y}_{lr}$		-		x_2''				$\hat{Y}_r$		$N\bar{y}_l$
Regression coef.	β	$\hat{\beta}$	B	b	-	-	k or β	b		k	β	$\hat{\beta}$	β	$\hat{\beta}$
[Stratified Sampling]														
No. of strata	L		L		-		L		L		K		K	
No. of units in st.	N_k	n_k	N_k	n_k	N_i	n_i	N_k	n_k	N_k	n_k	N_o	n_o	N_i	n_i

	Proposed		[1] Cochran		[4] Deming		[5] Hansen ...		[9] Konijn		[10] Murthy		[11] Sukhatme	
Samp.fraction in st.	f_k		f_k		n_i/N_i		f_k		n_k/N_k		n_s/N_s		n_i/N_i	
Stratum weight	W_k		W_k		N_i/N		N_k/N		N_k/N		W_s		p_i	
Variate	a_{ki}	x_{ki}	y_{ki}	y_{ki}	a_{ij}	x_{ij}	X_{ki}	x_{ki}	y_{ki}	y_{ki}	Y_{si}	y_{si}	y_{ij}	y_{ij}
Stratum mean	$\bar{a}_k$	$\bar{x}_k$	$\bar{Y}_k$	$\bar{y}_k$	$\bar{a}_i$	$\bar{x}_i$	$\bar{X}_k$	$\bar{x}_k$	$\bar{Y}_k$	$\bar{y}_k$	$\bar{Y}_s$	$\hat{\bar{Y}}_s$		
Stratum total	A_k	X_k			A_i	X_i	X_k	x'_k						
Population mean	$\bar{a}$	$\bar{x}$	$\bar{Y}$	$\bar{y}_{st}$	$\bar{a}$	$\bar{x}$	$\bar{X}$	$\bar{x}$	$\bar{Y}$	$\bar{y}_{st}$	$\bar{Y}$	$\hat{\bar{Y}}_{st}$	$\bar{y}_N$	$\bar{y}_w$
Population total	A	X	Y	$\hat{Y}_{st}$	A	X	X	x'	Y	$\hat{Y}$	Y	$\hat{Y}_{st}$	-	-
Variance	$\sigma_k^2=\frac{1}{N_k}\sum(a_{ki}-\bar{a}_k)^2$		-		σ_i^2		σ_k^2		-		σ_s^2		-	-
"	$S_k^2=\frac{1}{N_k-1}\sum(a_{ki}-\bar{a}_k)^2$	$s_k^2=\frac{1}{n_k-1}\sum(x_{ki}-\bar{x}_k)^2$	S_k^2	s_k^2			S_k^2	s_k^2	S_k^2	s_k^2	$\sigma_s'^2$	s_s^2	S_i^2	s_i^2
"	$\sigma_{WS}^2=\sum\frac{N_k}{N}\sigma_k^2$		-		σ_w^2	s_w^2	-		-		-		-	
"	$S_{WS}^2=\sum\frac{N_k}{N}S_k^2$	$s_{WS}^2=\sum\frac{N_k}{N}s_k^2$	S_w^2	s_w^2	-	-	S_w^2	s_w^2	-	-	-	-	-	-
"	$\bar{\sigma}_{WS}^2=(\sum\frac{N_k}{N}\sigma_k)^2$		-		$\bar{\sigma}_w^2$		-		-		-		-	
"	$\bar{S}_{WS}^2=(\sum\frac{N_k}{N}S_k)^2$		-				$\tilde{S}^2$		$\bar{S}^2$		$\bar{\sigma}^2$		$\bar{S}_W^2$	
Cost function	$K=k_0+\sum k_k n_k$		$C=c_0+\sum c_k n_k$				$C=\sum C_k n_k$		$C=c_0+\sum c_k n_k$		$C=C_0+\sum C_s n_s$		$C=\sum c_i n_i$	
[Cluster & Two-stage]														
No. of clusters	M	m	N	n	M	m	M	m	N	n	N	n	N	n
Cluster size	N_i	N'_i	M_i	M_i	N_i	N_i	N_i	N_i	M_i	M_i	M_i	M_i	M_i	M_i
Samp.size in cluster		n_i		m_i		n_i		n_i		m_i		m_i		m_i
Prob. for selection	P_i	P'_i	z_i	z_i	-	-	P_i	P_i	p_i	p_{jk}	P_i	p_i	P_i	-
Inclusion prob.	π_i	π'_i	π_i	π_i	-	-	-	-	π_i	$a_i\pi_i$	Π_i	π_i	-	-
Sampling fractions	f f_1	f_{2i} f_2	f f_1	f_{2i} f_2	- -	- -	f f_1	f_{2i} f_2			- -	f_i f	- -	- -
Variate of SSU	a_{ij}	x_{ij}	y_{ij}	y_{ij}	a_{ij}	x_{ij}	X_{ij}	x_{ij}	y_{ij}	y_{ij}	Y_{ij}	y_{ij}	y_{ij}	y_{ij}

	Proposed		[1] Cochran		[4] Deming		[5] Hansen ...		[9] Konijn		[10] Murthy		[11] Sukhatme	
Cluster mean	$\bar{a}_i$	$\bar{x}_i$	$\bar{y}_i$	$\bar{y}_i$	$\bar{a}_i$	$\bar{x}_i$	$\bar{X}_i$	$\bar{x}_i$	$\bar{Y}_{i\cdot}$	$\bar{y}_{j_k\cdot}$	$\bar{Y}_i$	$\bar{y}_i$	$\bar{y}_{i\cdot}$	$\bar{y}_{im}$
Cluster total	A_i	X_i	y_i	y_i	A_i	X_i	X_i	x'_i	$Y_{i\cdot}$	$y_{j_k\cdot}$	–	–	Y_i	–
Mean per cluster	$\bar{A}$	$\bar{X}$	$\bar{Y}$	$\bar{y}$	$\bar{A}$	$\bar{X}$	–	–	–	–	–	–	–	–
Population mean	$\bar{a}$	$\bar{x}$	$\bar{\bar{Y}}$	$\bar{\bar{y}}$	$\bar{a}$	$\bar{x}$	$\bar{X}$	$\bar{x}$	$\bar{\bar{Y}}$	$\hat{\bar{\bar{Y}}}$	$\bar{Y}$	$\hat{\bar{Y}}$	$\bar{y}_{\cdot\cdot}$	$\bar{\bar{y}}_{s_2}$
Population total	A	X	Y	$\hat{Y}$	A	X	X	x'	Y	$\hat{Y}$	Y	$\hat{Y}$	Y	$\hat{Y}$
Var. (between clus.)	$\sigma_c^2=\frac{1}{M}\sum(A_i-\bar{A})^2$		–		–		–		–		–		–	
"	$S_c^2=\frac{1}{M-1}\sum(A_i-\bar{A})^2$	$s_c^2=\frac{1}{m-1}\sum(X_i-\bar{X})^2$	–	–	–	–	$\frac{1}{M^2}S_{cX}^2$	$\frac{1}{m^2}s_{cx}^2$	$\bar{M}^2S_l^2$	$\bar{m}^2s_l^2$	–	–	–	–
"	$\sigma_{B1}^2=\frac{1}{M}\sum\frac{N_i}{\bar{N}}(\bar{a}_i-\bar{a})^2$		–		σ_b^2	s_b^2	σ_b^2		–		–		–	
"	$S_{B1}^2=\frac{1}{M-1}\sum\frac{N_i}{\bar{N}}(\bar{a}_i-\bar{a})^2$	$s_{B1}^2=\frac{1}{m-1}\sum(\bar{x}_i-\bar{x})^2$	–	–	–	–	–	–	–	–	–	–	–	–
"	$\sigma_{B2}^2=\frac{1}{M}\sum(\frac{N_i}{\bar{N}}\bar{a}_i-\bar{a})^2$		–		–		–		–		σ_b^2		–	
"	$S_{B2}^2=\frac{1}{M-1}\sum(\frac{N_i}{\bar{N}}\bar{a}_i-\bar{a})^2$	$s_{B2}^2=\frac{1}{m-1}\sum(\frac{n_i}{\bar{n}}\bar{x}_i-\bar{x})^2$	–	–	–	–	S_{1X}^2	s_{1X}^2	–	–	$\sigma_b'^2$	s_b^2	S_b^2	s_b^2
"	$\sigma_{B3}^2=\frac{1}{M}\sum(\frac{N_i}{\bar{N}})^2(\bar{a}_i-\bar{a})^2$		–		–		–		–		–		–	
"	$S_{B3}^2=\frac{1}{M-1}\sum(\frac{N_i}{\bar{N}})^2(\bar{a}_i-\bar{a})^2$	$s_{B3}^2=\frac{1}{m-1}\sum(\frac{n_i}{\bar{n}})^2(\bar{x}_i-\bar{x})^2$	–	–	–	–	–	–	–	–	–	–	$S_b'^2$	$s_b'^2$
"	$\sigma_{Pc}^2=\sum P_i(\frac{A_i}{P_i}-A)^2$	$s_{Pc}^2=\frac{1}{m-1}\sum(\frac{X_i}{P_i'}-X)^2$	–	–	–	–	S_X^2	s_X^2	–	–	–	–	–	–
"	$\sigma_{PB2}^2=\sum P_i(\frac{N_i}{P_i\bar{N}}\bar{a}_i-\bar{a})^2$	$s_{PB2}^2=\frac{1}{m-1}\sum(\frac{n_i}{P_i'\bar{n}}\bar{x}_i-\bar{x})^2$	–	–	–	–	–	–	–	–	–	–	–	–
"	$\sigma_{PB3}^2=\sum P_i(\frac{N_i}{P_i\bar{N}})^2(\bar{a}_i-\bar{a})^2$	$s_{PB3}^2=\frac{1}{m-1}\sum(\frac{n_i}{P_i'\bar{n}})^2(\bar{x}_i-\bar{x})^2$	–	–	–	–	–	–	–	–	–	–	–	–
Var. (within clus.)	$\sigma_i^2=\frac{1}{N_i}\sum(a_{ij}-\bar{a}_i)^2$		–		σ_i^2	s_i^2	–		–	–	σ_{wi}^2	–	–	–
"	$S_i^2=\frac{1}{N_i-1}\sum(a_{ij}-\bar{a})^2$	$s_i^2=\frac{1}{n_i-1}\sum(x_{ij}-\bar{x}_i)^2$	S_{2i}^2	s_{2i}^2	–		S_{2i}^2	–	$\frac{M_i}{\bar{M}}S_W^2(i)$	$\frac{M_i}{\bar{M}}s_W^2(i)$	$\sigma_{wi}'^2$	s_{wi}^2	S_i^2	s_i^2
"	$\sigma_W^2=\frac{1}{M}\sum\frac{N_i}{\bar{N}}\sigma_i^2$		–		σ_w^2	s_w^2	σ_w^2		S_W^2		σ_w^2		–	
"	$S_W^2=\frac{1}{M}\sum\frac{N_i}{\bar{N}}S_i^2$	$s_W^2=\frac{1}{m}\sum\frac{n_i}{\bar{n}}s_i^2$	–	–	–	–	S_{2X}^2	s_{2x}^2	–	–	–	–	$\bar{S}_w^2$	–
Intraclass correl.	ρ_c		ρ_w		–		δ		r		ρ_c		ρ	
Cost function	$K=k_0+k_1m+k_2n$		$C=c_1n+c_2nm$		$K=c_1m+c_2m\bar{n}$		$C=C_1m+C_2m\bar{n}$		$C=c_0+c_1n+c_2nm$		$C=C_0+C_1n+C_2nm$		$C=c_1n+c_2nm$	

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