

amin_phg@yahoo.com

EM

EM

EM

EM

(, ,)

EM

()

EM

...

(

)E

() M

.(,)

EM

: EM

EM

EM

EM

.()

(E)

EM

(M)

.()

(

(

 y_1, y_2, \dots, y_n x

$$\log \text{it}(E[Y_i|x_i]) = x_i^T \beta \quad ()$$

$$f(Y|X, \beta)$$

()

ML

 x

()

EM

 X Y

.()

$$f(Y, X | \Omega) = f(Y|X, \beta) f(X|\gamma) \quad ()$$

$$\Omega = (\beta, \gamma)$$

$$f(X; Y)$$

$$\beta$$

$$\beta$$

$$\beta$$

$$x$$

$$x$$

$$x$$

$$A$$

$$f(Y, X, A | \Omega^*) = f(Y | X, A, \beta^*) f(X, A | \gamma^*)$$

$$\Omega^* = (\beta^*, \gamma^*)$$

$$E(Y | X, A) = \int f(Y | X, A, \beta) f(\beta) d\beta$$

:()

$$f(Y, X, A | \theta) = f(A | Y, X, \alpha) f(Y | X, \beta) f(X | \gamma)$$

$$\theta = (\alpha, \beta, \gamma)$$

$$\sum_i l_{a,y,x}(\theta | a_i, y_i, x_i) = \sum_i \{ l_{a|y,x}(\alpha | a_i, y_i, x_i) + l_{y|x}(\beta | y_i, x_i) + l_x(\gamma | x_i) \}$$

X_i

$$\prod f(Y_i | X_i, \beta)$$

$$\beta$$

$$\alpha$$

$$\gamma$$

$$L_{a,y,x}^0(\theta) = \sum_i \log \sum_{x_{miss,i}} \{ L_{a|y,x}(\alpha | a_i, y_i, x_i) \times L_{y|x}(\beta | y_i, x_i) L_x(\gamma | x_i) \}$$

$$X = (x_1, x_2, \dots, x_p)$$

$$X_{miss,i}$$

β X $\gamma = (\gamma_1, \gamma_2, \dots, \gamma_r)$
 EM X γ $r = 2^3 - 1 = 7$
 $(\)$ c_1, \dots, c_p

E $\theta^{(t)}$ $L_{a,y,x}(\theta|a,Y,X)$ $r = c_1 \times \dots \times c_p - 1$
 $(y_i, x_{obs,i}, a_i)$ (β) $f(Y|X, \beta)$
 $X_{obs,i}$ (γ, α) $f(X|Y)$ $f(A|X, Y, \alpha)$
 P X

X_i X_i $r+1$ γ
 X_i x
 $Q(\theta|\theta^{(t)})$ $f(A|X, Y, \alpha)$ P
 $(\)$

$$Q(\theta|\theta^{(t)}) = \sum_{i=1}^n \sum_{j=1}^{r+1} w_{ij}^{(t)} L_{a,y,x}(\theta|a_i, y_i, x^j)$$

$$= \sum_{i=1}^n \sum_{j=1}^{r+1} w_{ij}^{(t)} \{l_{a|y,x}(\alpha|a_i, y_i, x^j) + l_{y|x}(\beta|y_i, x^j) + L_x(\gamma|x^j)\} \quad (1)$$

$x^j = x_{obs,i}$ X_i $L_{a,y,x}(\theta|a_i, y_i, x_i)$
 i θ j x^j

$$w_{ij}^{(t)} = p(x^j|a_i, y_i, x_{obs,i}, \theta^{(t)})$$

$$W_{it} = 1$$

x^j $X_{obs,i}$ w_{ij}

$X_{obs,i}$ x^j $X_{obs,i}$
 x^j $(\)$

$(\)$

$$W_{ij}^{(t)} = P(x^j | a_i, y_i, x_i, \theta^{(t)})$$

$$= \begin{cases} 0 & \text{if } x^j \text{ is not compatible with } x_i \\ \frac{p(y_i | x_i^j) p(a_i | x_i^j, y_i) p(x_i^j)}{\sum_{k \in \text{obs}_i} p(y_i | x_i^k) p(a_i | x_i^k, y_i) p(x_i^k)} & \text{if } x^j \text{ is compatible with } x_i \end{cases} \quad ()$$

p x^j
 $X_{obs,i}$ j

() M θ

β γ, α

()

θ ()

()

EM

s-plus

()

() EM

.()

EM

EM

EM .()

.()

.()

 $f(A|X, Y, \alpha), f(X; \delta)$

.()

 $f(A|Y, X)$

.(, ,)

EM

()

EM

(,)

:

l...

= =
= =
= =
=
=
= =
= =

EM

EM

/	/	/	/
/	/	/	/
/	/	/	/
/	/	/	/
/	/	/	/
/	/	/	/
/	/	/	/
/	/	/	/

References

- 7- Horton. N. J. and Laird. N. M. (2001) Maximum Likelihood Analysis of Logistic Regression Models with Incomplete Covariate Data and Auxiliary Information. *Biometrics* 2001, 57, 34-42.
- 8- Glynn, R. J. and Laird N. M. Regression Estimates and Missing Data: Complete Case Analysis. Unpublished Manuscript, Department of Biostatistics, Harvard University 1983.
- 9- Vach, W. Some Issues in Estimating the Effect of Prognostic Factors from Incomplete Covariate Data. *Statistics in Medicine* 1997 16, 57-72.
- 10- Vach, W. Logistic Regression with Missing Values in the Covariates. Berlin: Springer-Verlag 1994.
- 11- Louis, T. A. Finding the Observed Information Matrix When Using the EM Algorithm. *Journal of the Royal Statistical Society*, 1982 Series B 44, 226-233.
- 12- Rubin, D. B. Inference and Missing Data. *Biometrika* 1976 63, 581-592.
- 13- Saleh A. M. Some Methods for Dealing with Missing Data in Sample Surveys. Invited Papers Proceedings of the 7th Iranian Statistical Conference, 2004, 313-324
- 2- Little, R. J. Biostatistical Analysis with Missing Data. In *the Encyclopedia of Biostatistics*, Armitage, P. A. and Colton, T. , Eds., Wiley, Chichester U. K. , 1998
- 3- Levy, P. S. and Lemeshow, S. Sampling of Populations Methods and Applications. Third Edition John Wiley and Sons 1999;393-416.
- 4- Little, R. J. and Rubin, D. B. Statistical Analysis with Missing Data. Newyork: John Wiley and Sons.1987 .
- 5- Dempster, A. P., Laird, N. M., and Rubin, D. B. Maximum, likelihood from incomplete data via the EM algorithm. *Journal of the Royal Statistical Society*,1977; Series B39: 1-22.
- 6- Ibrahim, J. G. Incomplete data in generalized linear, models. *Journal of the American Statistical Association*, 1990, 85, 765-769.