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 y_1, y_2, \dots, y_n x

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

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

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

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

$$f(X; Y)$$

$$\beta$$

$$\beta$$

$$\beta$$

$$x$$

$$x$$

$$x$$

$$A$$

$$A$$

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

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

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

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

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

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

X_i

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

$$\beta$$

$$\gamma$$

$$\alpha$$

$$\beta$$

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

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

$$X_{miss,i}$$

$$\sum_{x_{miss,i}}$$

$$X_{miss,i}$$

$$\beta \quad X \quad \gamma = (\gamma_1, \gamma_2, \dots, \gamma_r)$$

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$$X \quad \gamma \quad r = 2^3 - 1 = 7$$

$$c_1, \dots, c_p$$

E

$$\theta^{(t)} \quad L_{a,y,x}(\theta|a,Y,X)$$

$$r = c_1 \times \dots \times c_p - 1$$

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

$$f(X|Y) \quad f(A|X, Y, \alpha)$$

$$(\beta) \quad \gamma, \alpha$$

$$X$$

$$X_{obs,i} \quad (y_i, x_{obs,i}, a_i)$$

$$P \quad i \quad X_i \quad r+1 \quad \gamma$$

$$X_i \quad x$$

$$Q(\theta|\theta^{(t)}) \quad f(A|X, Y, \alpha) \quad P$$

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

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

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

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

$$W_{it} = 1 \quad t$$

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

$$X_{obs,i} \quad x^j$$

$$: (1)$$

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

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

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

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

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 $f(A|Y, X)$

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References

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- 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.