

ERRATUM (FOR THE FIRST PRINTING OF “BAYESIAN MODELING USING WINBUGS”)

The following corrections were spotted in the first printing of the book and corrected to the second one.

Acknowledgements

I would like to express my gratitude to Dimitris Fouskakis (National Technical University of Athens, Greece), Louis Kates (Canada), MaryAnn Morgan-Cox (Baylor University, USA), Hao Liya (China) and Stefanos Dimitrakopoulos (University of Warwick, UK) for their corrections and comments on the first printing of the book.

Additionally, I would also like to thank for the intriguing queries , comments and discussions generated by Dipankar Bandyopadhyay (Medical University of South Carolina, USA), Han-Chiang Ho (Carlos III University, Spain), Jun Li (University of Alabama at Birmingham, USA), Su-Ping Liu (Carlos III University, Spain), Zane Zhang (Pacific Biological Station, Canada), Vijay Bonthapally (The University of Louisiana, USA), Ofir Levy, Harry Singh and Ryan Black.

Major corrections**Chapter 2**

1. **Page 44, last line:** Change equation to

$$\log f(\boldsymbol{\theta}|\mathbf{y}) = \text{constant} + \log f(\mathbf{y}|\boldsymbol{\theta}) + \log f(\boldsymbol{\theta})$$

Chapter 3

1. **Page 102, R output above section 3.4.6.3 (in grey):** Must be replaced by

```

, , 1
  [,1] [,2] [,3]
[1,]   1   3   5
[2,]   7   9  11
[3,]  13  15  17
[4,]  19  21  23
[5,]  25  27  29

, , 2
  [,1] [,2] [,3]
[1,]   2   4   6
[2,]   8  10  12
[3,]  14  16  18
[4,]  20  22  24
[5,]  26  28  30

```

Chapter 5

1. **Page 161, 4th line of section 5.3.1:** The correct code is

```
mu[i] <- beta0 + beta[1] * x[i,1] + ... + beta[p]*x[i,p]
```

2. **Page 163, line 8 of Section 5.3.3:** The code must be replaced by the following

```
precision <- tau/c2
for (j in 1:P){ beta[j] ~ dnorm( beta0[j], precision ) }
```

3. **Page 164, line 7 from the bottom of the page:** “x” must be replaced by “X” (capital) twice.

Chapter 7

1. **Page 236, line 4:** Equation must be changed to

$$g(\pi) = \frac{\pi^{\lambda_1 - \lambda_2} - 1}{\lambda_1 - \lambda_2} - \frac{(1 - \pi)^{\lambda_1 + \lambda_2} - 1}{\lambda_1 + \lambda_2},$$

[equal must be replaced by minus sign].

2. **Page 238, 6th line from the bottom:** Equation must be changed to

$$E(Y|X = x + 1) = \beta_0 + \beta_1(x + 1) = \beta_0 + \beta_1x + \beta_1 = E(Y|X = x) + \beta_1 \Leftrightarrow$$

[$E(y|X = x + 1)$ and $\mu(x)$ was changed to $E(Y|X = x + 1)$ and $E(Y|X = x)$ respectively].

Chapter 8

1. **Pages 279–280, last 3 lines of p.279 and 3 first lines of p.280:** WinBUGS code must be replaced by

```
for (i in 1:n){
  y[i] ~ dgamma( a[i], tau )
  a[i] <- mu[i]*tau
  log(mu[i]) <- eta[i]
}
s2 <- 1/tau
```

2. **Page 285, last paragraph:** Must be replaced by

Note that λ_j (i.e. the expected counts) have similar posterior means under both Poisson and negative binomial models, but have different posterior variance since the dispersion of the sampling distribution is larger for the NB model. This leads to posterior distributions with wider 95% posterior intervals for the λ_j of the NB model.

3. **Page 292, 1st line of code:** Delete the first line of the code.
4. **Page 293, line 7:** Add the following line of code

```
miny[i] <- min(y1[i], y2[i]) + 1
```

Chapter 10

1. **Page 349, last line:** The correct equation is

$$T[i-L] = T_i = \sum_{a=1}^L Y.T_{i-L,a}$$

2. **Page 350, lines 2–3:** The correct equations are

$$\sum_{a=1}^L Y.T_{i-L,a} = \sum_{a=1}^{i-L} Y.T_{i-L,a} + \sum_{a=i-L+1}^L Y.T_{i-L,a} = \sum_{a=i-L+1}^L Y_{a,i+1-a}$$

and $\sum_{a=1}^{i-L} Y.T_{i-L,a} = 0$.

3. **Page 361, in both WinBUGS code bits:** The sign before $0.5*\log(\tau)$ must change to plus (+). Also Figures 10.8 and 10.9 in page 362 must be updated with the correct ones which follow

(see also http://stat-athens.aueb.gr/~jbn/winbugs_book/home.html).

Chapter 11

1. **Page 423, 3rd line of section 11.10.1:** Equation

$$f(\mathbf{y}|\mathbf{y}, m) = \int f(\mathbf{y}|\boldsymbol{\theta}_m, m) f(\boldsymbol{\theta}_m|m) d\boldsymbol{\theta}_m$$

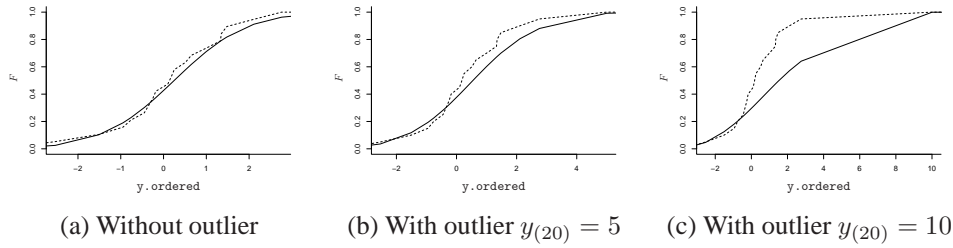


Figure 10.8 Observed (dashed line) and estimated predictive (solid line) cumulative distribution for Example 10.3.

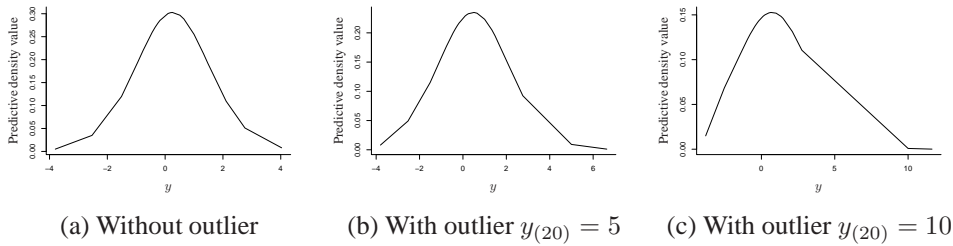


Figure 10.9 Estimated predictive density function for Example 10.3.

must be replaced by

$$f(\mathbf{y}|\mathbf{y}, m) = \int f(\mathbf{y}|\boldsymbol{\theta}_m, m) f(\boldsymbol{\theta}_m|\mathbf{y}, m) d\boldsymbol{\theta}_m$$

2. **Page 428, 3rd paragraph of section 11.11.4:** The paragraph must be changed to the following:

Another estimate of of the minimum deviance (and hence of AIC and BIC) can be obtained via calculation of the posterior Bayes factor. As we have described in Section 11.10, the PBF is simply given as a ratio of the posterior predictive densities of two competing models which can be estimated by the posterior mean of the likelihood $f(\mathbf{y}|\boldsymbol{\theta}_m, m)$ from MCMC outputs. Hence we may obtain an estimate of the minimum deviance by

$$\widetilde{\text{min}D}(\boldsymbol{\theta}_m, m) = -2 \log \overline{f(\mathbf{y}|\boldsymbol{\theta}_m, m)} - d_m \log(2)$$

using the result of O’Hagan (1995) which expresses the PBF as an information criterion with penalty equal to $\log(2)$. Then an information criterion of type (11.37) can be estimated by

$$\widetilde{\text{IC}}(m) = \widetilde{\text{min}D}(\boldsymbol{\theta}_m, m) + d_m F .$$

Minor corrections

Table of Contents

1. Page xiii: “11.9 ~~R~~Reversible jump MCMC (RJMCMC)”

Chapter 1

1. Page 3, Section 1.2, 2nd paragraph, 3rd line: Delete comma and add “is” after \mathcal{V} .
2. Page 6, 2nd paragraph, step 5: “select between using ~~an~~ a noninformative prior or incorporating ~~the prior~~ preceding known information and/or experts’ opinion in our prior distribution).”
3. Page 8, 2nd line: x must be replaced by λ .
4. Page 8, 3rd line: $\lambda^{n\bar{y}+a}$ must be replaced by $\lambda^{n\bar{y}+a-1}$.
5. Page 8, 1st line after equation (1.1): $\tilde{a} \rightarrow \tilde{\alpha}$.
6. Page 9, last line: $\sqrt{2\pi\sigma^2} \rightarrow \sqrt{2\pi\sigma^2}$.
7. Page 10, line 7: $(2\pi\sigma^{-2})^{-n/2} \rightarrow (2\pi\sigma^2)^{-n/2}$
8. Pages 9–11 and 14: π must be replaced by Π .
9. Page 13, 2nd line from the bottom: “... an inverse gamma distributions+...”
10. Page 18, line 8: “... first~~is~~...”.
11. Page 29, Problem 1.10: change the lines referring to data to the following format

0.671	1.412	-2.119	1.224	-1.168	-0.860	1.936	3.396	4.808	-1.259
0.275	1.820	2.417	2.929	7.020	0.483	6.483	2.966	0.942	-3.398
2.846	3.840	6.640	1.018	2.747	1.857	7.270	2.734	4.325	-1.222

Chapter 2

1. Page 38, line 4 of 2nd paragraph: “... sufficient ...” \rightarrow “... insufficient ...”.
2. Page 43, lines 10–12: “Nevertheless, in practice, ~~the~~ choice of the proposal is important~~ee~~ since poor choices will considerably delay convergence towards the equilibrium distribution.”
3. Page 53, 6th line from the bottom: $b o \rightarrow b \times o$
4. Page 81, Problem 2.2.c: “Of winning”.

Chapter 3

1. **Page 86, 2nd bullet:** Must be replaced by
 - Update the chain (Update)
 - Monitor the acceptance rate of the Metropolis–Hastings algorithm (Monitor Met)
2. **Page 86, last two lines:** “The Inference menu is also a valuable menu since, with its available set of operations, that we can ”.
3. **Page 87, line 9:** “The menu item Samples is the most frequently used tool. With Using this tool, ...”
4. **Page 87, 9th line from the bottom of the page:** “... conceive of the structure ...”.
5. **Page 92, line 6:** “... with $i = 1, 2, \dots$ ” [add a space].
6. **Page 99, 4th line from the bottom of the page:** “... $\theta = (a, b, \sigma^2) \dots$ ” → “... $\theta = (\alpha, \beta, \sigma^2) \dots$ ” [change a and b to greek letters].
7. **Page 101, line of code after Vectors:** Remove the curly bracket at the end of the code.
8. **Page 107, Section 3.4.6.8, line 4:** “... recommend to defining a simple model ...”.
9. **Page 108, 1st line of 2nd paragraph of Section 3.4.8:** “From the WinBUGS team, we it is recommended specifying any transformations ...”.
10. **Page 115, lines 6–7 of 6-b:** “... that we recommend using large refresh values ...”.
11. **Page 117, 2nd line:** “... this procedure is called “setting the monitored parameters.””.

Chapter 4

1. **Page 126, 2nd line:** “... to the previous season.”.
2. **Page 140, 1st line of Section 4.2.5:** Delete the word “deviance”.
3. **Page 141, 1st line:** “... and possible problems ...”
4. **Page 142, lines 2-3 of Section 4.3.2:** “... are visually separatedly ...”
5. **Page 146, 1st line after bullets:** “see Figure ...” → “See Figure ...”

Chapter 5

1. **Page 153, 1st line above WinBUGS code:** Delete the word “commands”.
2. **Page 156, lines 5–6 of the 1st paragraph after Table 5.1:** “Frequently In such cases, direct interpretation of β_0 does may not lead to realistic and sensible interpretation.”
3. **Page 160, lines 1–2 after Figure 5.1:** “Concerning the posterior distribution of σ , we observe that with the current model we can predict the expected delivery time with with an a-posteriori expectation expected error of 3.4 minutes.”

4. **Page 162, line 5:** $\mu_i = \beta X_{(i)} \rightarrow \mu_i = X_{(i)}\beta$.
5. **Page 162, line 8:** The code `mu[i] <- inprod(beta[], X[i,])` can be optionally replaced by `mu[i] <- inprod(X[i,], beta[])`. [*The old syntax is also correct. The change was made to be in concordance with the linear predictor in line 5*].
6. **Page 162, line 5 of Section 5.3.2:** Move “ $P = p + 1$ ” here from 2nd line above equation (5.6).
7. **Page 168, line 3:** “... effects of ℓ ~~+~~ level ...”.
8. **Page 168, Equations 5.9 and 5.10:** y must be changed to capital.
9. **Page 169, 2nd line from the end of Section 5.4.2.2:** change “effects” to “values”.
10. **Page 175, 4th line after Equation 5.15:** “... denote ~~to~~ the mean ...”.
11. **Page 184, 2nd line of Section 5.4.6:** “... interpretation is ~~has~~ similar ...”.

Chapter 6

1. **Page 192, lines 4–5 of 3rd paragraph:** “... indicating ~~the likelihood~~ that ~~we may remove~~ parameters of this term ~~can be eliminated from the model~~.”
2. **Page 192, line 3 of 4th paragraph:** “... (1) ~~both~~ all interactions ...”
3. **Page 196, caption of Figure 6.1** must change to “Boxplots of parameters for interaction models for Example 6.1; asterisk indicates that all lower interaction terms are also included in the model.”
4. **Page 199, line 5 of 2nd paragraph:** $\ell > 2 \rightarrow \ell \geq 2$.
5. **Page 209, 2nd line of 2nd (unnumbered) Equation:** The minus sign must change to plus.
6. **Page 209, lines 3–4 of last paragraph:** “This comparison might be misleading since the ~~generated values~~ for the two ~~variables~~ ~~parameters~~ are highly correlated (see Figure 6.7).”
7. **Pages 209 and 210, lines 5–6 of last paragraph of page 209 and 1st line of page 210:** “Indeed, from the posterior density of the difference (see Figure 6.8), we observe the zero value (equal intercepts) lying at the right tail area of the ~~posterior~~ distribution ~~of the difference~~.”
8. **Page 213, lines 5–6 after Equation 6.10:** Delete “ β_0 and β'_0 ”.
9. **Page 213, line 8 after Equation 6.10:** “while for STZ ~~the slopes are equal to~~ ~~$\beta_0 = \beta_1 - \delta_2$~~ and ~~$\beta'_0 = \beta_1 + \delta_2$~~ with relative potency given by”
10. **Page 216, line 5:** Delete full stop between the words “used” and “but”.
11. **Page 217, 2nd line of last paragraph:** “... indicates that ~~to~~ the models ...”.
12. **Page 223, 2nd line in “Results”:** “saturated” \rightarrow “full”.
13. **Page 226, 1st line:** “these parameters” \rightarrow “ β_1, β_2 and β_4 ”.

Chapter 7

1. **Page 229, line 7:** "They can ...".
2. **Page 236, 2nd line from the bottom:** "... but we might ~~ignore~~ **be ignorant** of the exact time of failure."
3. **Page 237, lines 1–2:** "Binary (zero–one) data (i.e., $y \in \{0, 1\}$) can be modeled using the Bernoulli distribution ~~(i.e., $y \in \{0, 1\}$)~~."
4. **Page 241, last line before Section 7.3:** " $i = 1, \dots, N$ " \rightarrow " $i = 1, \dots, n$ "
5. **Page 250, line 3:** "Concerning the Poisson assumption, slight overdispersion **has been reported** in literature."
6. **Page 257, line 3:** "... binomial." \rightarrow "... Bernoulli."
7. **Page 259, line 8:** "These two facts ~~findings~~ **founded** odds ratios ...".
8. **Page 259, 4th line from the bottom:** "... the effect of ~~every~~ **each** covariate ...".
9. **Page 261, 6th line after equation 7.9:** " $\pi = \frac{1}{2}$ " \rightarrow " $\pi_0 = \frac{1}{2}$ ".
10. **Page 262, line 13:** "To be more specific, ε_i follows the Gumbel ..." \rightarrow "To be more specific, $-\varepsilon_i$ follows the Gumbel ..." (ε_i must change to $-\varepsilon_i$).
11. **Page 263, 12th line of Section 7.5.2.1:** "... without **any** problem."
12. **Page 265, 6th line of the computational note:** " $\xi \geq 4$ " \rightarrow " $\xi \geq 5$ ".
13. **Page 268, line 8:** $3 - -9 \rightarrow 3-9$.

Chapter 8

1. **Page 280, 3rd paragraph of Section 8.2.2, first line:** Delete the word "Finally".
2. **Page 280, 4th paragraph of Section 8.2.2, lines 1–4:** Must be replaced by the following:

Finally, the Weibull distribution is used with probability density function

$$f(y|\lambda, v) = v\lambda y^{v-1} e^{-\lambda y^v},$$

mean $E(Y) = \lambda^{-1/v} \Gamma(1+v^{-1})$, and variance $V(Y) = \lambda^{-2/v} (\Gamma(1+2/v) - \Gamma(1+1/v)^2)$.

3. **Page 282, Section 8.3, lines 4–5:** "... this extra **(or lower)** variability."
4. **Page 283, Section 8.3.1, 2nd line from the end of 2nd paragraph:** Add du at the end of the integral. The correct expression is the following:

$$f(y) = \int_0^\infty f(y|u)f(u)du = \frac{\Gamma(y+r)}{y!\Gamma(r)} \left(\frac{r}{r+\lambda}\right)^r \left(\frac{\lambda}{r+\lambda}\right)^y,$$

5. **Page 283, Section 8.3.1, 2nd line of 3rd paragraph:** "... [complementary log (i.e. clog) on π, \dots "]

6. **Page 283, Section 8.3.1, 4th line of 3rd paragraph:** "... [~~ie~~ which is equivalent to setting $\text{logit}(\pi) = -r - \eta]$..."
7. **Page 292, 2nd paragraph, line 2:** "... or directly ~~on~~with the marginal means $\lambda_1 + \lambda_3$ and $\lambda_2 + \lambda_3$."
8. **Page 292, equation in the middle of the page:** The probability function of the bivariate Poisson must be corrected to

$$f_{BP}(y_1, y_2) = \sum_{k=0}^{\min(y_1, y_2)} \frac{e^{-\lambda_1} \lambda_1^{y_1-k}}{(y_1 - k)!} \frac{e^{-\lambda_2} \lambda_2^{y_2-k}}{(y_2 - k)!} \frac{e^{-\lambda_3} \lambda_3^k}{k!}$$

[$y_1 - k$ must be replaced by $y_2 - k$ in the second term of the summation].

9. **Page 297, Section 8.4.1, 2nd paragraph, line 7:** Replace equation with the following correct expression:

$$h(y) = \lim_{\delta y \rightarrow 0} \frac{P(y \leq Y < y + \delta y | Y > y)}{\delta y}.$$

10. **Page 297, below equation in the 5th line from the bottom:** Add "for right censored data" after the equation.
11. **Page 297, last line:** Delete "In WinBUGS,".
12. **Page 298, 3rd paragraph, line 4:** Delete right parenthesis after $x_{(i)}$.
13. **Page 301, 2nd paragraph, line 5:** "For ~~an~~ a smooth ...".
14. **Page 302, line 1:** "Use a normal distribution ~~of~~ for the logarithms of the data above.".
15. **Page 302, line 5 of Problem 8.3:** "I(a,)" \rightarrow "I(,)"
16. **Page 302, line 5 of Problem 8.4:** "I(a,)" \rightarrow "I(,)"

Chapter 9

1. **Page 305, line 2:** "... can be considered **as** one level of hierarchy,"
2. **Page 305, Caption of Figure 9.1:** Change comma (,) to period (.) after word "model".
3. **Page 310, line 3:** $I_2 \rightarrow I_K$
4. **Page 310, 2nd line from the end of Section 9.2.1.2:** "... books ..." \rightarrow "... book's ...".
5. **Page 312, line 1:** "The posterior distributions of ~~within-between-subject~~ and ~~between-within-subject~~ variabilities (σ_a^2 and σ^2 , respectively) ..."
6. **Page 313, Section 9.2.2.1, line 1:** "~~This~~ The model of Section 9.2.2 assumes that ..."
7. **Page 313, Section 9.2.2.1, line 3:** "... simple ..." \rightarrow "... simply ..."
8. **Page 316, line 2:** $u_i \rightarrow r_i$.

9. **Page 325, Section 9.3.2, line 8:** "... within-patient ~~variability~~ **correlation**."
10. **Page 327, 5th line from the bottom:** The index k should start from one ($k = 1$) instead of zero.
11. **Page 330, 3rd line after Table 9.14:** "... which is lower than the corresponding **values for** models with ..."
12. **Page 338, 3rd paragraph, lines 2–7:** "Interesting ... (Draper, 1995)." must be replaced by

Interesting books on the subject include the more recent ones by Hedeker and Gibbons (2006), Brown and Prescott (2006), and de Leeuw and Meijer (2008), while a variety of papers on the topic can be found in the related special issue of the *Journal of Educational and Behavioral Statistics* (vol. 20, issue no. 2, 1995), including the fruitful critical review by Professor D. Draper (Draper, 1995).

Chapter 10

1. **Page 342, line 11:** "... of ~~again re~~observing ~~in the future~~ each y_i ..."
2. **Page 342, 2nd line from the bottom:** "... is not clear ~~directly~~ which ..."
3. **Page 344, last two lines of Section 10.1.3:** Delete these two lines.
4. **Page 347, line 11 of Section 10.2.2:** "... in actuarial practice ~~to be able~~ to precisely estimate such quantities in order to ..."
5. **Page 357, line 11:** "intervalus" → "intervals".
6. **Page 368, lines 8–9:** "Moreover, these ~~checks tests~~ are useful ..."
7. **Page 378, 6th line from the bottom:** "schme" → "scheme".
8. **Page 387, 2nd paragraph, 1st line:** "A further interesting area for implementation of predictive inference ~~is can be found~~ in problems ..."

Chapter 11

1. **Page 392, 3rd line of Section 11.3:** "... focus ~~on~~ attention ~~to~~ on the simpler ..."
2. **Page 392, 5th line of Section 11.3.1:** "... ~~where with~~ $H_m(\tilde{\theta}_m)$ ~~is being~~ equal to ..."
3. **Page 406, 3rd paragraph, 2nd line:** $\gamma_i \rightarrow \gamma_j$ (twice).
4. **Page 409, lines 3-4 from the bottom:** "... in the case where ~~a~~ the data matrix X ~~with~~ has orthogonal columns X_j (appearing in (11.12)) and the imposed priors are intended to be noninformative.
5. **Page 411, lines 3-4 from the bottom:** "... replace the pseudopriors required by ~~Carlin and Chib's (Carlin and Chib, 1995) GVS~~."
6. **Page 413, line 2:** "... we ~~can~~ accurately estimate ..."

7. **Page 421, line 6 from the bottom of Section 11.9:** “The WinBUGS jump interface, ~~more~~ recently developed by Dave Lunn, . . .”
8. **Page 421, last line:** Delete comma after equal.
9. **Page 422, last line of 2nd paragraph:** “. . . see the appendix in ~~f~~ Draper and Krnjajić (2006).”
10. **Page 424, line 2:** “Let us ~~again~~ reconsider Example 5.1.”
11. **Page 427, lines 2–3 of 4th paragraph:** “. . . (2) criteria that are asymptotically valid under the assumption that a true model does ~~not~~ exist. ”.
12. **Page 428, 1st line of 4th paragraph in section 11.11.4:** AIB → AIC.

Appendix A

1. **Page 435, line 4:** Add a comma after “programming”.
2. **Page 435, last line:** Add a parenthesis after σ^2 .
3. **Page 439, 1st paragraph, last line:** “Any node included in panels ~~will~~ **must** depend on the index of the surrounding panel.”

Appendix C

1. **Page 448, line 3 of Section C.3:** “ordering” → “order”
2. **Page 453, paragraphs 1–2:**

~~is~~ The output of Example 1.4 as implemented in Section 4.1 is used in the following ~~we~~ to briefly illustrate the use of CODA for obtaining the diagnostics of Geweke (1992), Raftery and Lewis (1992) and Heidelberger and Welch (1992). Illustration of the Gelman–Rubin diagnostic (Gelman and Rubin, 1992) is omitted since it can be implemented in WinBUGS, as illustrated in Section 4.3.3. In the following we assume that we have generated one chain. _____
 _____ The output file is saved under the name CODAoutput1.txt and the index file, under the name CODAoutputIndex.txt.

ERRATUM (FOR THE SECOND PRINTING OF “BAYESIAN MODELING USING WINBUGS”)

The following corrections were spotted in both the first and second printings of the book and will be corrected in a possible future third printing.

Acknowledgements

Special thanks to Michael E. Meredith (Wildlife Conservation Society Malaysia Program, Malaysia) for sending a detailed report with comments, suggestions and errors that helped me to improve the book in the 3rd printing.

I would also like to thank Chengjin Chu for his queries on the “within-subject correlation”, and Mark Chambers for noting a correction in page 313. Finally I would like to thank Phil Turk for his useful comments and corrections.

Corrections

Chapter 1

1. **Page 11, 2nd equation:** In the NG density, multiply by $c^{-1/2}$.
2. **Page 58, Table 2.7, 6th line of R code:** Change the code values to “`prop.s<-c(0.2,0.2)`”.
3. **Page 59, caption of Figure 2.10:** At the end of the caption add that “ $(\bar{s}_{\beta_0} = \bar{s}_{\beta_1} = 0.2)$ ”.

Chapter 2

1. **Page 53, equation in the 2nd line from the bottom:** The correct expression is

$$A = \log \frac{f(y|o')f(o')}{f(y|o)f(o)} + \log \frac{f_{\Gamma}(o; o'/b, 1/b)}{f_{\Gamma}(o'; o/b, 1/b)}$$

[the numerator of second term of A must change to o'/b from an o/b].

2. **Page 62, Number 3 in the list:**

3. Propose a new value $\beta' = (\beta'_0, \beta'_1)^T$ from $N_2(\beta, S_{\beta})$.

3. **Page 63, Table 2.8, line 7 in R code:**

```
> c.beta<- 1.752.5
```

4. **Page 63, Table 2.8, lines 21–23 in R code:**

```
+as.numeric( 0.5*log( det( cur.Tprop.T ) ) -0.5*t(current.beta-prop.beta)
%% prop.T %% (current.beta-prop.beta)
```

5. **Page 66, Table 2.9, line 6 in R code:**

```
> prop.s<-c(1.5,0.15,1.75,0.2)
```

6. **Page 68, caption of Figure 2.15:**

Figure 2.15 MCMC moves and generated values for logistic regression parameters of Example 2.3 using a single-component random-walk algorithm. ~~the contour on upper left of each graph refers to the proposal distribution at the initial (0,0) step.~~

Chapter 3

1. **Page 120, 2nd paragraph after bullets, line 6:** Change 0.1% to 1% which is a more realistic value.

Chapter 6

1. **Page 192, 2nd paragraph from the bottom:** Add “This is sensible since no observations are available for males and females living in a village and having high economic status; see Table 5.14.” at the end of the paragraph.
2. **Page 202, 1st block of code:** “beta1 x[i]” → “beta1*x[i]”.
3. **Page 202, 2nd block of code:** “beta0.star[k]” → “beta0.star[1]” and “beta1.star[k]” → “beta1.star[1]”.
4. **Page 214, Table 6.12:** Caption must be replaced with “WinBUGS code for common intercept/different slopes model in Example 6.2”.
5. **Page 214, Table 6.12, lines 17–23:** Remove comment sign # from the commands for flat priors (lines 21–23) and put it in the commands for the normal priors (lines 17–19).

6. **Page 215, caption of Table 6.13:** Must be replaced by “WinBUGS code for common intercept/different slopes model in Example 6.2 using design matrix approach and rescaled dose^a”
7. **Page 215, Table 6.13, lines 24–25:** Remove comment sign # from the commands for flat priors (line 25) and put it in the commands for the normal priors (line 24).
8. **Page 215, footnote of Table 6.14:** Must be replaced by “^aResults using code of Table 6.12 (flat priors).”
9. **Page 216, 2nd line of 2nd Paragraph:** “Thus we can infer that the clotting time is a posteriori expected to be equal to 72 seconds when ~~no dilution no preparation~~ is used but to be reduced by 4.9 seconds when we increase the dose of the standard treatment by the minimum quantity (1:40) of the experiment.”
10. **Page 222, last block of code:** “k + 1” must be replaced by “k” in equals.

Chapter 7

1. **Page 242, 4th paragraph, 1st line:** “The link function can be enhanced facilitated by four link functions that are available in WinBUGS: . . .” → “Four link functions are available in WinBUGS: . . .” .
2. **Page 244, 2nd paragraph, line 9:** “. . . (i.e., $X_i = j$) . . .” → “. . . (i.e., $X_i = k$) . . .”.
3. **Page 246, last equation:** “-0.18 bombload_i” → “+0.18 bombload_i” (change minus to plus).
4. **Page 247, 3rd bullet:** “Every additional ~~year~~month . . .”.
5. **Page 248, 2nd paragraph, line 5:** “. . . the minimum flying experience (50 ~~hours~~ months) corresponds to an expected number of 3.7 and . . .”.
6. **Page 258, Table 7.15, 1st equation:** $\pi = \frac{e^{\text{odds}}}{1+e^{\text{odds}}} = \frac{e^a}{1+e^a} \rightarrow \pi = \frac{\text{odds}}{1+\text{odds}} = \frac{a}{1+a}$.
7. **Page 258, Table 7.16, 4th bullet:** “The success odds when ~~Y=1~~X = 1 . . .”.
8. **Pages 265 and 266, computational notes:** Substitute x by η . A simpler syntax suggested by Mike Meredith (Malaysia) is the following

```
probit( p[i] ) <- max( min( eta[i], xi ), -xi)
```

for the probit link and

```
cloglog( p[i] ) <- max( min( eta[i], xi2 ), xi1)
```

for the clog-log link.

Chapter 8

1. Page 285, 2nd paragraph in "Results":

Dispersion indices of NB as well as DIC values indicate that the NB model is much better than the Poisson one. Concerning DIs, these range from 7.6 to 12.7 and from 9.3 to 15.8 for males and females, respectively, indicating a clear overdispersion. Moreover, DIC values for the NB model is much lower than the corresponding value for the Poisson model. ~~Note that, for the GLM approach DIC was not calculated by WinBUGS. For this reason the corresponding value was calculated outside WinBUGS using the posterior means of the deviance measure and π_j and r_j ($j = 1, 2$); see Sections 4.2.5 and 6.4.3 for details concerning the computation of DIC.~~

since DIC can be calculated in WinBUGS for this model.

2. Page 286, Table 8.5:

- First line, 2nd column: "NB — simple" → "NB — GLM"
- First line, 3rd column: "NB — GLM" → "NB — simple"
- Last line, 2nd column: "2874.36" is substituted by "2873.85" (DIC value from WinBUGS). The two values are close and they differ due to Monte Carlo error and different parametrization used.
- The footnote must be now removed.

3. Page 294, Table 8.7: The actual values (2nd column) must be corrected by the following

- β_{12} : 0.0
- β_{13} : 0.1
- β_{24} : 0.0
- β_{25} : -0.5

Chapter 9

- Page 309, 1st line above equation 9.1***: "Thus, we can calculate the ~~within-subject~~ **intrasubject (or within-subject)** correlation by . . ."
- Page 313, 1st equation & Page 313, 2nd line from the bottom**: In " $Y_t \sim \text{binomial}(\pi_t, N)$ ", substitute N by N_t .
- Page 326, 1st line after 2nd block of equations***: ". . . resulting in ~~within-subject~~ **intrasubject (or within-subject)** correlation of the latent measurement equal to . . ."
- Page 332, Caption of Table 9.16***: The phrase "(or intrasubject)" was added after "within-subject". Thus must be replaced by "Posterior means of within-subject **(or intrasubject)** correlations for random effects model, including intrasubscale variability for SPQ data of Example 9.7"

*The term intrasubject correlation is used to avoid confusion which may be caused by "within-subject" term which has different meaning when referring to variability. Additionally to the above changes, the term within-subject correlation also appears in pages 325, 330 and 331 which were not changed since (I believe) that can be understood by looking at the rest of the text.

5. **Page 334, 1st line after the 1st block of equations***: “From this expression, the ~~within-subject~~ **intrasubject (within-subject)** correlation depends on the fixed linear predictor μ_{it} and therefore on the covariate values. Indicative values will be reported on the basis of sample means, sample minimums and maximums ~~values~~ of the observed covariates.”

Chapter 11

1. **Page 403, equation after 11.6**: The correct expression is

$$f(\mathbf{y}|m) = \frac{\Gamma(a + n/2)}{\Gamma(a)} (2\pi)^{-n/2} b^a c^{-F_m} \left(\frac{|\tilde{\Sigma}_m|}{|\mathbf{V}_m|} \right)^{1/2} \left(\frac{1}{2} \mathbf{SS}_m + b \right)^{-n/2-a},$$

2. **Page 411, equation 11.25**: Must be changed to

$$\frac{f(\gamma_j = 1 | \mathbf{y}, \gamma_{\setminus j}, \boldsymbol{\beta})}{f(\gamma_j = 0 | \mathbf{y}, \gamma_{\setminus j}, \boldsymbol{\beta})} = k_j^{-d_j} \exp \left(-\frac{1}{2} (1 - k_j^2) \boldsymbol{\beta}_j^T \boldsymbol{\Sigma}_j^{-1} \boldsymbol{\beta}_j \right), \quad (5.1)$$

3. **Page 415, 2nd block of code, 1st line**: Add right parenthesis after 0.5.
 4. **Page 416, 1st line**: Add right parenthesis after 0.5.
 5. **Page 421, 1st line**: $\boldsymbol{\beta}'_{(m')} \rightarrow \boldsymbol{\beta}'_{m'}$.

ERRATUM (FOR THE THIRD PRINTING OF “BAYESIAN MODELING USING WINBUGS”)

The following corrections were spotted in the first, second and third printings of the book and corrections will be available via the book’s website.

Acknowledgements

I would like to thank

- Olalekan Uthman (University of Birmingham) for his corrections on example 9.4.
- Magdalini Daskalopoulou (Athens University of Economics and Business) for her corrections in Chapters 1 and 3.
- Efstratia Charitidou and Dimitris Fouskakis (National Technical University of Athens) for their corrections in Chapter 11.
- Philip Turk his corrections and comments in Chapters 2, 3, 8, 11 and in the Appendix.
- Dinos Perakis for his corrections in Chapters 8 and 9.
- Gudbjort Gylfadottir for his correction in Chapters 1.
- Efstratia Charitidou for her in Chapters 1, 2 and 11.
- Gheorghe Doros for his corrections in Chapters 8 and 9 (especially for correcting the variance of the zero inflated models in page 288).

2 ERRATUM (FOR THE FIRST PRINTING OF "BAYESIAN MODELING USING WINBUGS")

- Vladimir Britikov (correction of gamma coefficient in page 9); David Evans (summation in eq. 8.6); Quan Li (clarification in page 17)

Corrections

Chapter 1

- Page 3, lines 7–8 of Section 1.3:** This equation is also called *Bayes' rule*, ~~although~~ and it was ~~originally~~ also found **independently** by Piere-Simon de Laplace **in 1774** ...
- Page 4, paragraph above Section 1.4:** Using similar arguments we can calculate the probability of a nonsmoker to develop the disease, which is equal to ~~0.0099~~ **0.00577** and the relative risk (RR) is equal to

$$RR = \frac{P(\text{case}|\text{smoker})}{P(\text{case}|\text{nonsmoker})} = \frac{0.0185}{\del{0.0099} \mathbf{0.00577}} = \del{1.87} \mathbf{3.2} .$$

Therefore, the probability for a smoker to develop lung cancer is **87% higher than** ~~3.2 times~~ the corresponding probability for nonsmokers.

- Page 7, 2nd line from the bottom:**

$$f(\lambda) = \frac{b^a}{\Gamma(a)} \del{a-1} \lambda^{a-1} e^{-b\lambda}.$$

- Page 9, lines 4 and 7:** $\frac{\Gamma(a)\Gamma(b)}{\Gamma(a+b)} \rightarrow \frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)}$

- Page 10, 6th line of the 2nd block of equations:**

$$\propto \exp\left(-\frac{1}{2} \left\{ \left[\frac{n}{\sigma^2} + \frac{1}{\sigma_0^2} \right] \mu^2 - 2\mu \left[\frac{n\bar{y}}{\sigma^2} + \frac{\mu_0}{\sigma_0^2} \right] \right\}\right)$$

- Page 11, 1st line after 2nd equation:** In $\text{NIG}(\tilde{\mu}, \tilde{c}, \tilde{a}, b)$ and $\text{NG}(\tilde{\mu}, \tilde{c}, \tilde{a}, b)$, b must be replaced by \tilde{b} .
- Page 12, 2 lines above Section 1.5.5:** ~~$n > 2 - 2a$~~ and ~~$n > 4 - 2a$~~ .
- Page 17, line 6:** The actual posterior distributions are $\text{gamma}(8.001, 8.001)$ and $\text{gamma}(4.001, 8.001)$ assuming the prior described in the previous sections. Parameters are rounded to the closest integer for simplicity.

Chapter 2

- Page 33, equation in the middle of the page:**

$$\del{Y}_0 \sim \text{binomial}(\pi_0, n_0) \text{ and } \del{Y}_1 \sim \text{binomial}(\pi_1, n_1)$$

- Page 39, 2nd equation in item 2:** A square root sign is missing from the right part of the equation. The correct expression is the following

$$\widehat{SD}(G(\boldsymbol{\theta})|\mathbf{y}) = \sqrt{\frac{1}{T' - 1} \sum_{t=1}^{T'} [G(\boldsymbol{\theta}^{(t)}) - \widehat{E}(G(\boldsymbol{\theta})|\mathbf{y})]^2} .$$

4 ERRATUM (FOR THE FIRST PRINTING OF "BAYESIAN MODELING USING WINBUGS")

1. **Page 46, 2nd paragraph, 3rd line:** "... convergence of the chain cannot be accelerated ..."
2. **Page 63, last line of the R code:** $H=T \rightarrow H=H$.
3. **Page 77, after second enumeration:** "Clearly, in 2 3, ..."
4. **Page 79, the title of the computational not:** COMPUTATIONAL NOTE (~~DI~~ for mixture models WinBUGS) (Sampling from truncated distributions)

Chapter 3

1. **Page 96, 2nd line from the bottom:** "... and for $x < a, \dots$ " \rightarrow "... and for $x < -a, \dots$ ".
2. **Page 105, 3rd lines of the 3rd block of code:** Must be replaced by
2, 14, 5, 17, 8, 20, 11, 23,

Chapter 4

1. **Page 126, equation after the 1st code:** Add subscript i in π :

$$\prod_{i=1}^8 \pi_i^{y_i} (1 - \pi)^{N_i - y_i} \rightarrow \prod_{i=1}^8 \pi_i^{y_i} (1 - \pi_i)^{N_i - y_i}$$

Chapter 8

1. **Page 279, 4th line of Section 8.2.1:** The variance is equal to $\text{Var}(Y_i) = \mu_i \tau^{-1}$.
2. **Page 283, 2nd line after the DI expression:** The correct variance expression is $V(Y) = \lambda(\lambda + r)/r$.
3. **Page 283, 8th line from the bottom:** The correct expression is $\text{logit}(\pi) = \log(r) - \eta$ instead of $\text{logit}(\pi) = -r - \eta$.
4. **Page 288, 8th line from the bottom:** The correct expression for the variance is

$$V(Y) = (1 - \pi_0) \left(V(Y_D) + \pi_0 [E(Y_D)]^2 \right);$$

i.e. $E(Y_D)$ must be raised in the power of two. The corresponding codes of example 8.3 were corrected and uploaded in the web-page.

5. **Page 288, 7th line from the bottom:** The correct expression for DI is $\text{DI} = V(Y_D)/E(Y_D) + \pi_0 E(Y_D)$.
6. **Page 291, rows 13–16 of Table 8.6:** The results using the correct formula for the variance in page 288 are the following:

Parameter ^a	ZIP	ZINB	ZIGP	Generalized Poisson
Var(Y_1)	18.62 (16.60, 20.82)	43.89 (33.26, 59.46)	45.01 (33.13, 62.86)	71.47 (43.65, 122.4)
Var(Y_2)	17.27 (15.61, 19.00)	35.48 (26.47, 48.10)	37.50 (27.00, 52.95)	75.44 (40.71, 144.0)
DI ₁	3.18 (2.74, 3.67)	7.44 (6.08, 9.27)	7.66 (6.09, 7.54)	12.00 (8.38, 17.52)
DI ₂	4.03 (3.61, 4.48)	8.22 (6.77, 10.15)	8.64 (6.91, 8.51)	16.87 (11.07, 26.79)

7. **Page 292, lines 9–10 in the WinBUGS code:** x_3 must be substituted by z_3 . The correct code is the following

```
z1[1] <- y1[i] - z3[i]
z2[1] <- y2[i] - z3[i]
```

8. **Page 293, lines 2 and 6 of Example 8.4:** The actual sample size is 200 and not 100.
9. **Page 297, 5th line from the bottom:** The correct expression for the likelihood of a survival model is given by

$$f(\mathbf{y}|\boldsymbol{\xi}, \boldsymbol{\theta}) = \prod_{i=1}^n f(y_i|\boldsymbol{\theta})^{1-\xi_i} S(y_i|\boldsymbol{\theta})^{\xi_i}$$

10. **Pages 299, eq. 8.6:** The subscript in the summation must be j and not i and should take values from 1 to p ; correct expression $\sum_{j=1}^p$.

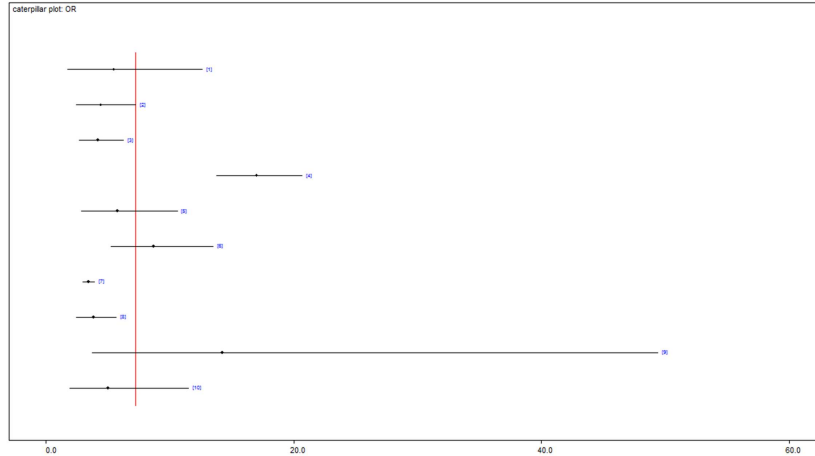
Chapter 9

- Pages 310, 3rd line:** $\sigma I_2 \rightarrow \sigma^2 I_K$.
- Pages 315, line 2 of the 2nd paragraph:** The DIC value is actually 73.1 and not 67.8 (which is the \bar{D}).
- Pages 319–321, example 9.4:** The data for study 8 and the code of this example was wrong. More specifically
 - Page 319, Table 7:** The odds ratio for the 7th study is ~~12.41~~3.41.
 - Page 319, 1st line after the block of equations:** $\hat{\sigma}_k^2$ must be replaced by $\hat{\sigma}_k$.
 - Page 320, 1st block of code:** The correct code is the following

```
for (k in 1:K1){
  logor[k] <- log(or[k])
  selogor[k] <- log(U[k]/L[k])/(2*1.96)
  precision.logor[k] <- 1/pow( selogor[k], 2)
  logor[k] ~ dnorm( theta[k], precision.logor[k] )
  logor[k] ~ dnorm( theta[k], selogor[k] )
  theta[k] ~ dnorm( mu.theta, tau.theta )
  OR[k] <- exp(theta[k])
}
```

d. **Page 320, 2nd paragraph from the end of Section:** The posterior mean of the overall odds ratio is found equal to ~~5.285.92~~, with 95% of the posterior values ranging from ~~3.333.55~~ to ~~9.059.44~~. Error bars of the estimated odds ratios of each study using the hierarchical model presented above are depicted in Figure 9.6.

e. **Page 321, Figure 9.6:** must be replaced by the following figure



The corrected pages of this example will be also available in a pdf file in the book's website.

4. **Pages 328, 3rd line from the bottom:** $n = 60$ is missing. The correct data code is the following

```
list( n=60, F=c(0,7, 9,23,60), Y1=c(0,1,0,1), Y2=c(0,0,1,1) )
```
5. **Pages 330-331:** Items must be denoted with t instead of j ; similarly s_j must be replaced by s_t .

Chapter 11

1. **Page 391, lines 3–5 of Section 11.2:** Let us consider the usual normal prior distribution for θ under the ~~null~~ alternative hypothesis centered around the value of the alternative H_0 .
2. **Page 396, 6th line from the bottom:**

$$= \hat{f}(\theta_1^* | \mathbf{y}, m) \prod_{j=1}^d \hat{f}(\theta_j^* | \theta_1^*, \dots, \theta_{j-1}^*, \mathbf{y}, m)$$

3. **Page 396, 3rd and 4th line from the bottom:**

$$\hat{f}(\theta_1^* | \mathbf{y}, m) = \frac{1}{T} \sum_{t=1}^T f(\theta_1^{*(t)} | \theta_2^{(t)}, \dots, \theta_d^{(t)}, \mathbf{y}, m)$$

$$\hat{f}(\theta_j^* | \theta_1^*, \dots, \theta_{j-1}^*, \mathbf{y}, m) = \frac{1}{T} \sum_{t=1}^T f(\theta_j^{*(t)} | \theta_1^{*(t)}, \dots, \theta_{j-1}^{*(t)}, \theta_{j+1}^{(t)}, \dots, \theta_d^{(t)}, \mathbf{y}, m).$$

4. **Page 415**, : "... when we use independent priors ~~are used~~ ..."
5. **Page 416, lines 4 and 5**: Must be replaced by

```
mb0 <- prop.mean.beta0  
taub0 <- (gamma0/n + (1-gamma0))/pow(prop.sd.beta0, 2)
```

Appendix A

1. **Page 440, line 8 (number 7 in the list)**: Must be deleted since it is stated also in line 4.
2. **Page 440, 2nd line from the bottom (number 3 in the second list)**: " $a \rightarrow \mu_a$ " \rightarrow " $\mu_a \rightarrow a$ ".