# Additional information for the paper: "Is the Hypothesis Correct" or "Is it not". Bayesian Evaluation of One Informative Hypothesis in ANOVA

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In the article titled "Is the Hypothesis Correct" or "Is it not", Bayesian Evaluation of One Informative Hypothesis in ANOVA, it is shown how to compute the complexity and fit for inequality constrained models using WinBUGs(Lunn, Thomas, Best, & Spiegelhalter, 2000). This is further explained in Appendix A and Appendix B.

## References

Lunn, D., Thomas, A., Best, N., & Spiegelhalter, D. (2000). Winbugs - a bayesian modelling framework: concepts, structure, and extensibility. *Statistics and Computing*, *10*, 325 - 337.

## Appendix A
## Computation of $c_i$ in WinBUGS

This Appendix shows how WinBUGS can be used to compute the complexity. The WinBUGS code of both examples is given below.

### *A.1 WinBUGS code for Example 1*

```
MODEL {

# Specification of the prior [1]
mu1~dnorm(0.0,0.001)
mu2~dnorm(0.0,0.001)
mu3~dnorm(0.0,0.001)
mu4~dnorm(0.0,0.001)
# Calculation of the complexity [2]
c1< −step(mu1-mu2)
c2< −step(mu1-mu3)
c3< −step(mu1-mu4)
complexity< −c1*c2*c3
```

}
[1] Here, the priors are specified with the parameters $\mu_0$ and $\tau_0^2$ as given in Equation (**??**). Note that specification of the prior for $\sigma^2$ is not necessary for the computation of $c_i$.

[2] As shown in Section 4.3, the proportion of $\boldsymbol{\mu}^t$ for $t = 1, \ldots, T$ in agreement with $H_i$ needs to be computed. First, $c1 - c3$ checks if the relations between the separate means are in accordance with $H_i$, these are the same steps as given in Equation (**??**). Secondly, *complexity* checks if all the relations are in agreement with $H_i$. Finally, to obtain the proportion of $\boldsymbol{\mu}^t$ in agreement with $H_i$, the mean of *complexity* can be requested in WinBUGS.

*A.2 WinBUGS code for Example 2*

MODEL {

*# Specification of the prior*
mu1∼dnorm(0.0,0.001)
mu2∼dnorm(0.0,0.001)
mu3∼dnorm(0.0,0.001)
mu4∼dnorm(0.0,0.001)
mu5∼dnorm(0.0,0.001)
*# Calculation of the complexity* [3]
c1< −step(mu1-mu2)
c2< −step(mu2-mu3)
c3< −step(mu3-mu4)
c4< −step(mu4-mu5)
complexity< −c1*c2*c3*c4

}

[3] As in the WinBUGS code of Example 1, here the proportion of $\boldsymbol{\mu}^t$ for $t = 1, \ldots, T$ in agreement with $H_i$ is calculated by the steps given in Equation (**??**).

# Appendix B
# Computation of $f_i$ in WinBUGS

This Appendix shows how the fit can be computes using WinBUGS. The WinBUGS code of both examples is given below.

## *B.1 WinBUGS code for Example 1*

MODEL{

*#Specification of the likelihood* [1]
for(i in 1:n){
mu[i] < − mu1*d1[i] + mu2*d2[i] + mu3*d3[i] + mu4*d4[i]
y[i] dnorm(mu[i],inv-$\sigma^2$)}
*# Specification of the prior* [2]
mu1∼dnorm(0.0,0.001)
mu2∼dnorm(0.0,0.001)
mu3∼dnorm(0.0,0.001)
mu4∼dnorm(0.0,0.001)
inv-$\sigma^2$∼dgamma(0.01,0.01)
*# Calculation of the fit* [3]
f1< −step(mu1-mu2)
f2< −step(mu1-mu3)
f3< −step(mu1-mu4)
fit< −f1*f2*f3
}

*# Specification of the data* [4]
list( n=120)

| $y$[] | $d1$[] | $d2$[] | $d3$[] | $d4$[] |
|---|---|---|---|---|
| 0.332 | 1 | 0 | 0 | 0 |
| 0.212 | 1 | 0 | 0 | 0 |
| ... | | | | |
| ... | | | | |
| 0.341 | 0 | 0 | 0 | 1 |
| 0.289 | 0 | 0 | 0 | 1 |

END

*# Specification of the initial values* [5]
list(mu1=1.0, mu2=1.0, mu3=1.0,mu4=1.0,inv-$\sigma^2$=1.0)

[1] For the computation of the fit, the likelihood function needs to be specified, this is based on the general likelihood function of ANOVA model as given in Equation (**??**).

[2] The priors for $\boldsymbol{\mu}$ are specified with the parameters $\mu_0$ and $\tau_0^2$ as given in Equation (**??**).

[3] As shown in Section 4.3, the proportion of $\boldsymbol{\mu}^t$ for $t = 1, \ldots, T$ from the posterior distribution in agreement with $H_i$ needs to be computed. First, $f1 - f3$ checks if the relations between the separate means are in accordance with $H_i$, these are the same steps as given in Equation (**??**). Secondly, $fit$ checks if all the relations are in agreement with $H_i$ and finally to obtain the proportion of $\boldsymbol{\mu}^t$ in agreement with $H_i$ the mean if $fit$ can be requested in WinBUGS.

[4] The data need to be specified.

[5] The initial values for the parameters of the prior need to be specified.

*B.2 WinBUGS code for Example 2*

MODEL{

*#likelihood*
for(i in 1:n){
mu[i] < − mu1*d1[i] + mu2*d2[i] + mu3*d3[i] + mu4*d4[i] + mu5*d5[i]
y[i] dnorm(mu[i],inv-$\sigma^2$)}
*#priors*
mu1∼dnorm(0.0,0.001)
mu2∼dnorm(0.0,0.001)
mu3∼dnorm(0.0,0.001)
mu4∼dnorm(0.0,0.001)
mu5∼dnorm(0.0,0.001)
inv-$\sigma^2$∼dgamma(0.01,0.01)
f1< −step(mu1-mu2)
f2< −step(mu2-mu3)
f3< −step(mu3-mu4)
f4< −step(mu4-mu5)
fit< −f1*f2*f3*f4
}

*# Specification of the data*
list( n=1491)

| $y$[] | $d1$[] | $d2$[] | $d3$[] | $d4$[] | $d5$[] |
|---|---|---|---|---|---|
| 1.754 | 1 | 0 | 0 | 0 | 0 |
| −.875 | 1 | 0 | 0 | 0 | 0 |
| −.016 | 1 | 0 | 0 | 0 | 0 |
| ... | | | | | |
| ... | | | | | |
| −.424 | 0 | 0 | 0 | 0 | 1 |
| .445 | 0 | 0 | 0 | 0 | 1 |
| −.253 | 0 | 0 | 0 | 0 | 1 |

END

*# Specification of the initial values*
list(mu1=1.0, mu2=1.0, mu3=1.0,mu4=1.0,mu5=1.0,inv-$\sigma^2$=1.0)