Assignment Statistics 5

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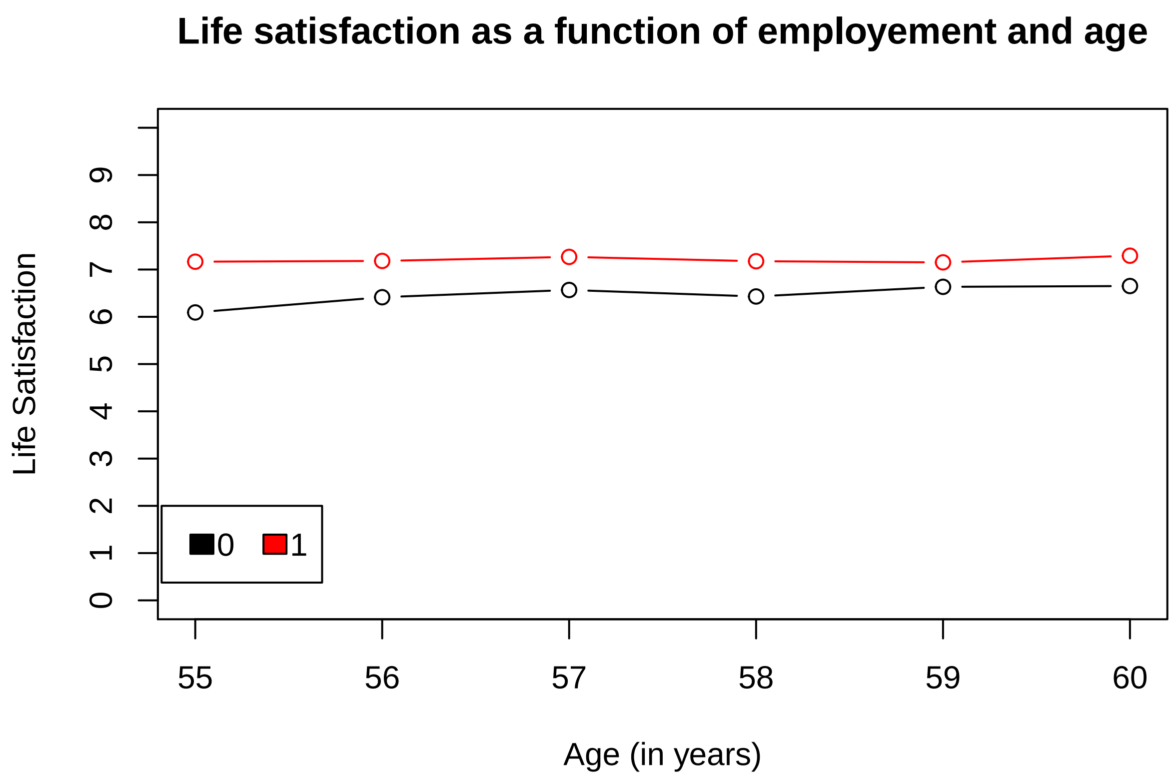
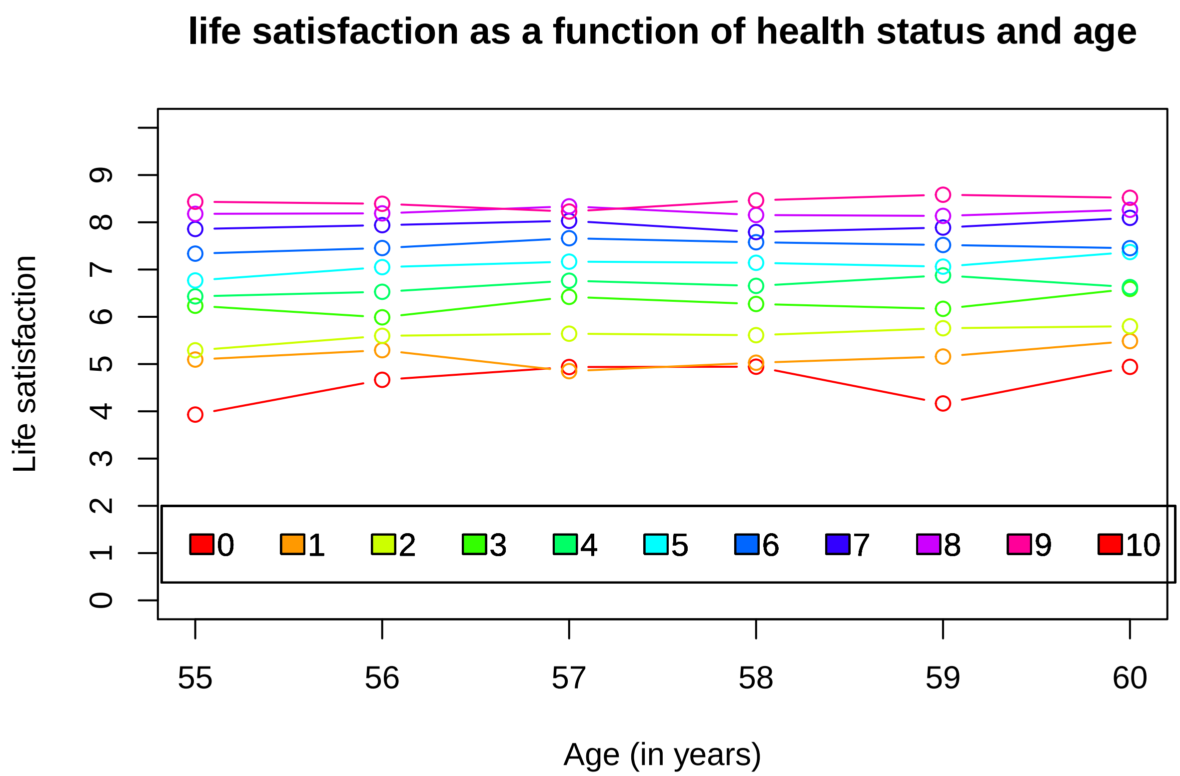
plots-1.pdf

plots-2.pdf


Life satisfaction as a function of employement and age
Life Satisfaction
0
1
2
3
4
5
6
7
8
9
0
1
55
56
57
58
59
60
Age (in years)

plots-3.pdf



Research question

We explored the question of which factors are associated with life satisfaction in the german sample of $n=$1236 using bayesian regression techniques. Preceding the analysis, we omitted all missing values, and standardized all non-binary variables. We centered age for MCMC considerations. We also aimed to investigate whether we could construct a model that could examine whether living together has an effect on life satisfaction, when taking into account individual differences, as posited by Lucas, Clark, Georgellis, and Diener (2003). To this extent, we assured that this variable could interact with other variables of intrest, and correlated with baseline individual differences.

Method

We constructed a complex bayesian hierarchical regression model, with life satisfaction as dependent variable, henceforth termed y_i and then proceeded to construct a more simple model based on the exploratory conclusions from the first. Our first model took into account the variables of health satisfaction, living together, and employment status as a between subjects factor, henceforth termed x_{2i}, x_{3i}, and x_{4i} respectively. Age was included as x_{1i}. We included interactions between age and health satisfaction, age and partner, age and employment, and health and employment. The choices of these interactions were motivated by the fact that the "age" variable changes equally for each individual, and interactions between this variable and the others seemed most likely to influence life satisfaction. Our final interaction was motivated by the idea that the association of these variables could manifest its self in concrete outcomes pertaining to work and health combinations. We used JAGS to provide us with samples from the posterior.

In all our models, we assumed $y_i \sim N(\text{ţ}_{yi}, \sigma)$

with $\sigma \sim U(0.1, 1)$

model 1

$\text{ţ}_{yi} = \beta_{0i} + \beta_{2i}x_{2i} + \beta_{3i}x_{3i} + \beta_4 x_{4i} + \beta_5 x_{1i}x_{2i} + \beta_6 x_{1i}x_{3i} + \beta_6 x_{1i}x_{4i} + \beta_7 x_{2i}x_{4i}$

β_{0i} to $\beta_{3i} \sim N(\beta_{\text{ţ}}, M)$

and $\beta_{\text{ţ}} \sim N(0, 0.0001)$

and $M \sim wish(1, 4)$

With the between subjects and interactions β's distributed as $N(0, \frac{1}{10^5})$

model 2

$\text{ţ}_{yi} = \beta_{0i} + \beta_{2i}x_{2i} + \beta_{3i}x_{3i} + \beta_4 x_{4i} + \beta_5 x_{1i}x_{2i}x_{4i}$

with β_{0i} and $\beta_{3i} \sim N(\beta_{\text{ţ}}, M)$

and $\beta_{\text{ţ}} \sim N(0, 0.0001)$.

our non-correlating β_2 and the between subjects and interactions β's $\sim N(0, \frac{1}{10^5})$.

$y_i = \beta_{0i} + \beta_{2i}x_2 + \beta_{3i}x_3 + \beta_4 x_4 + \beta_5 x_1 x_2 + \beta_6 x_1 x_3 + \beta_7 x_1 x_4 + \beta_8 x_2 x_4$

Exploring the data

We found that age could best be conceptualised as a factor interacting with our other variables. Therefore, We plotted life satisfaction as a function of living together and age, with living together is 1 and not living together 0 (see Figure 1), life satisfaction as a function of employment and age, with full time employed as 1 and partially -or, not employed as 0 (see Figure 2) and life satisfaction as a function health status and age with perceived health status ranging from 0-10 (see Figure 3).

JAGS specifics

In order to assure convergence, we used a burn-in of 1000. We used 2000 iterations of the MCMC to assess the key models. For the first model, we set a thinning value of 180 to assure no autocorrelation in the sampling. For the second model, a thinning value of 200 was used. These values were based on autocorrelation plots of exploratory runs of both models.

Comparing the models using the Deviance Information Criterion (DIC)

To compare the trade off between complexity and data description of our models, we used the deviance information criterion (DIC). From the analysis we obtained DIC values of ‘r dic.1.main´ and ´r dic.2.main´ for the first and second model respectively. We can interprete this as following" the model with the lowest DIC value is the model with the smallest trade-off which in this case is our first model.

Sensitivity analysis of the models

To assess whether our models were robust against choices of our pirors, we fully randomised the means of the priors of the distributions from which our parameters were sampled, using random uniform distributions between -5 and 5. We also reduced the broadness of our precision and variance parameters, from $\frac{1}{10^5}$ to $\frac{1}{10^2}$. We found that these adaptations caused no interesting differences in our models posterior. The results of these analyses can be found in table 3 and table 4. The difference in DIC criterium between the first model and it's sensitiviy analysis was neligable(2.23and 2.23). For our second, less complex model, the DICs were also comparable (2.45 and 2.45).Furthermore, the trend in which our first model obtained the lowest DIC can also be found in the sensitivity analysis models (2.23 and 2.45).

Discussion

Since our DIC test suggested the more complex model to provide a better trade-off between model complexity and data description, we decided to use this model to interpret how life satisfaction changes according to changes in other variables over time for different individuals. Since the SSEFF of the components are quite similar, it is easy to interpret the findings shown in Table 1. We found that our main effect variable of β_{2i} pertaining to health satisfaction was indeed important in describing differences in life satisfaction. Interestingly, the β_{4i} pertaining to employment status demosntrated a positive relationship between being employed at this age, and life satisfaction. This too was in accordance with our exploratory analysis of the data. An interaction plot between age, employment, and life satisfaction given our models prediction can be found in Figure 4. While Lucas, Clark, Georgellis, & Diener (2003) reported that on average, living together did not seem to have an effect on life satisfaction, we did find that our β_{3i} value had a mean ($M_{\beta_{3i}} = 0.19$) and a standard deviation ($SD_{\beta_{3i}} = .04$), indicating an influence. However, the authors also noted that there were large individual differences in this group. By allowing individual differences in this variable, we may have captured it's effect more accurately. Furthermore, The only relatively large correlation we found between our within-subject variables was between β_{0i} and β_{3i}, indicting that living together is correlated with other baseline individual differnces in the data. This does to some extent confirm the conclusions of Lucas et al. (2003), although we did not test this assumption directly.

References

Lucas, R. E., Clark, A. E., Georgellis, Y., & Diener, E. (2003). Reexamining adaptation and the set point model of happiness: Reactions to changes in marital status. *Journal of Personality and Social Psychology*, *84*(3), 527.

Table 1

The first model

	Lower95	Median	Upper95	Mean	SD	Mode	MCerr	MC%ofSD	SSeff	AC.1800	psrf
ss[1]	0.54	0.60	0.66	0.60	0.03	0.60	0.00	2.20	2,000.00	-0.01	1.00
ss[2]	0.26	0.29	0.32	0.29	0.02	0.29	0.00	2.20	2,000.00	0.02	1.00
ss[3]	0.42	0.57	0.72	0.57	0.08	0.56	0.00	2.20	2,000.00	-0.02	1.00
cor12	-0.02	-0.01	0.01	-0.01	0.01	-0.01	0.00	2.10	2,363.00	-0.01	1.00
cor13	-0.36	-0.21	-0.08	-0.22	0.08	-0.20	0.00	2.20	2,000.00	-0.02	1.00
cor23	-0.15	-0.07	0.00	-0.07	0.04	-0.06	0.00	2.20	2,000.00	-0.03	1.00
betamu[1]	-0.39	-0.30	-0.21	-0.30	0.05	-0.29	0.00	2.00	2,551.00	0.00	1.00
betamu[2]	0.30	0.35	0.40	0.35	0.03	0.35	0.00	2.20	2,106.00	-0.02	1.00
betamu[3]	0.11	0.19	0.27	0.19	0.04	0.19	0.00	2.20	2,060.00	0.01	1.00
betax[1]	0.13	0.21	0.29	0.21	0.04	0.21	0.00	2.30	1,880.00	-0.02	1.00
betax[2]	-0.03	-0.02	0.00	-0.02	0.01	-0.02	0.00	2.20	2,000.00	0.04	1.00
betax[3]	-0.04	-0.01	0.03	-0.01	0.02	-0.01	0.00	2.20	2,098.00	0.00	1.00
betax[4]	-0.02	0.02	0.05	0.02	0.02	0.02	0.00	2.30	1,903.00	0.02	1.00
betax[5]	0.01	0.07	0.14	0.08	0.03	0.08	0.00	2.20	2,000.00	-0.01	1.00

Note. Full model.

Table 2

The Second model

	Lower95	Median	Upper95	Mean	SD	Mode	MCerr	MC%ofSD	SSeff	AC.2000	psrf
ss[1]	0.58	0.65	0.74	0.66	0.04	0.65	0.00	1.70	3,650.00	0.01	1.00
ss[2]	0.42	0.61	0.78	0.61	0.09	0.60	0.00	1.70	3,452.00	0.01	1.00
cor12	-0.46	-0.24	-0.09	-0.25	0.10	-0.23	0.00	1.70	3,421.00	0.01	1.00
betamu[1]	-0.35	-0.24	-0.13	-0.24	0.06	-0.24	0.00	1.60	4,000.00	-0.04	1.00
betamu[2]	0.07	0.18	0.28	0.18	0.05	0.18	0.00	1.60	3,787.00	-0.01	1.00
betax[1]	0.08	0.19	0.29	0.19	0.05	0.20	0.00	1.60	4,000.00	-0.03	1.00
betax[2]	-0.01	0.01	0.02	0.01	0.01	0.01	0.00	1.70	3,441.00	-0.01	1.00
sigma	0.59	0.61	0.62	0.61	0.01	0.61	0.00	1.60	4,000.00	0.00	1.00

Note. Reduced model.

Table 3

Sensitivity 1

	Lower95	Median	Upper95	Mean	SD	Mode	MCerr	MC%ofSD	SSeff	AC.1500	psrf
ss[1]	0.54	0.60	0.66	0.60	0.03	0.60	0.00	2.30	1,879.00	-0.04	1.00
ss[2]	0.26	0.29	0.32	0.29	0.02	0.28	0.00	2.30	1,905.00	0.00	1.00
ss[3]	0.42	0.57	0.73	0.57	0.08	0.58	0.00	2.20	2,116.00	0.00	1.00
cor12	-0.02	-0.01	0.01	-0.01	0.01	-0.01	0.00	2.20	2,000.00	0.01	1.00
cor13	-0.36	-0.21	-0.08	-0.22	0.08	-0.20	0.00	2.20	2,070.00	0.00	1.00
cor23	-0.16	-0.07	0.00	-0.07	0.04	-0.07	0.00	2.10	2,309.00	-0.01	1.00
betamu[1]	-0.39	-0.30	-0.22	-0.30	0.05	-0.30	0.00	2.30	1,875.00	-0.02	1.00
betamu[2]	0.29	0.35	0.40	0.35	0.03	0.35	0.00	2.10	2,178.00	-0.02	1.00
betamu[3]	0.10	0.18	0.27	0.18	0.04	0.18	0.00	2.20	2,000.00	0.02	1.00
betax[1]	0.13	0.21	0.29	0.21	0.04	0.22	0.00	2.20	2,150.00	0.02	1.00
betax[2]	0.01	0.08	0.14	0.07	0.03	0.07	0.00	2.10	2,271.00	0.00	1.00
betax[3]	-0.04	-0.01	0.03	-0.01	0.02	-0.01	0.00	2.20	2,000.00	0.01	1.00
betax[4]	-0.03	-0.02	0.00	-0.02	0.01	-0.02	0.00	2.20	2,000.00	0.01	1.00
betax[5]	-0.01	0.02	0.06	0.02	0.02	0.02	0.00	2.20	2,000.00	0.00	1.00
betax[6]	-0.01	0.00	0.01	0.00	0.01	0.00	0.00	2.30	1,945.00	0.00	1.00
sigma	0.59	0.60	0.62	0.60	0.01	0.60	0.00	2.20	2,000.00	0.01	1.00

Note. Sensitivity analysis 1.

Table 4

Sensitivity 2

	Lower95	Median	Upper95	Mean	SD	Mode	MCerr	MC%ofSD	SSeff	AC.3000	psrf
ss[1]	0.57	0.66	0.73	0.66	0.04	0.66	0.00	2.50	1,600.00	0.02	1.01
ss[2]	0.42	0.61	0.78	0.61	0.09	0.61	0.00	2.50	1,600.00	0.00	1.00
cor12	-0.44	-0.25	-0.09	-0.26	0.10	-0.22	0.00	2.50	1,600.00	0.00	1.00
betamu[1]	-0.34	-0.25	-0.13	-0.25	0.06	-0.26	0.00	2.40	1,748.00	0.03	1.00
betamu[2]	0.08	0.18	0.28	0.18	0.05	0.18	0.00	2.50	1,600.00	0.04	1.00
betax[1]	0.09	0.20	0.29	0.20	0.05	0.20	0.00	2.50	1,644.00	-0.02	1.00
betax[2]	-0.01	0.01	0.02	0.01	0.01	0.01	0.00	2.50	1,600.00	0.00	1.00
sigma	0.59	0.60	0.62	0.60	0.01	0.60	0.00	2.50	1,600.00	-0.04	1.01
rand	-9.23	-0.04	8.79	-0.03	4.96	0.10	0.12	2.40	1,710.00	0.01	1.00
rand2	-9.12	0.14	9.11	0.06	5.41	0.48	0.14	2.50	1,600.00	0.01	1.00

Note. Sensitivity analysis 2.