Bayesian data analysis – reading instructions 6

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Chapter 6

Outline of the chapter 6

- 6.1 The place of model checking in applied Bayesian statistics
- 6.2 Do the inferences from the model make sense?
- 6.3 Posterior predictive checking (p-values can be skipped)
- 6.4 Graphical posterior predictive checks
- 6.5 Model checking for the educational testing example

R and Python demos at https://avehtari.github.io/BDA_course_Aalto/demos.html

- demo6_1: Posterior predictive checking - light speed
- demo6_2: Posterior predictive checking - sequential dependence
- demo6_3: Posterior predictive checking - poor test statistic
- demo6_4: Posterior predictive checking - marginal predictive p-value

Find all the terms and symbols listed below. When reading the chapter, write down questions related to things unclear for you or things you think might be unclear for others.

- model checking
- sensitivity analysis
- external validation
- posterior predictive checking
- joint posterior predictive distribution
- marginal (posterior) predictive distribution
- self-consistency check
- replicated data
- y^{rep}, $\tilde{y}$, $\tilde{x}$
- test quantities
- discrepancy measure
- tail-area probabilities
- classical p-value
- posterior predictive p-values
- multiple comparisons
- marginal predictive checks
- cross-validation predictive distributions
- conditional predictive ordinate

Replicates vs. future observation

Predictive $\tilde{y}$ is the next not yet observed possible observation. y^{rep} refers to replicating the whole experiment (with same values of x) and obtaining as many replicated observations as in the original data.

Posterior predictive p-values

Section 6.3 discusses posterior predictive p-values, which we don't recommend any more especially in a form of hypothesis testing.

Prior predictive checking

Prior predictive checking using just the prior predictive distributions is very useful tool for assessing the sensibility of the model and priors even before observing any data or before doing the posterior inference. See additional reading below for examples.

Additional reading

The following article has some useful discussion and examples also about prior and posterior predictive checking.

- Jonah Gabry, Daniel Simpson, Aki Vehtari, Michael Betancourt, and Andrew Gelman (2018). Visualization in Bayesian workflow. *Journal of the Royal Statistical Society Series A*, , 182(2):389-402. https://doi.org/10.1111/rssa.12378.
- Video of the paper presentation https://www.youtube.com/watch?v=E8vdXoJId8M

And some useful demos

- Graphical posterior predictive checks using the bayesplot package http://mc-stan.org/bayesplot/articles/graphical-ppcs.html
- Another demo demos_rstan/ppc/poisson-ppc.Rmd