Presentations with LaTeX

Pedro Fonseca
Advisor: Prof Dr. Rui Paulo

ISEG Lisbon School of Economics & Management

April 23, 2020

Contents

How to make an itemized list

- This is a beamer presentation template
- It is customised with ISEG colors

How to make an itemized list

You can also have text without bullets. And mix it with itemized lists in the same slide:

- random item 1
- random item 2

itemized lists inside itemized lists

- You can have itemized lists inside other itemized lists:
  - This is a sub item
  - This is another sub item
- You can even have sub sub items:
  - subitem
    - subsub item 1
    - subsub item 2
    - subsubitem 3

I built this template to

- Help ISEG students
- Improve my latex skills

Mathematical notation

- LaTeXis very useful to typeset mathematical notation. For example, this is the formula for Benford's law of first digits:

$$P(D_1 = d_1) = \log\left(1 + \frac{1}{d_1}\right), d_1 \in \{1, \ldots, 9\}$$

- You can also use inline mathematical formulas instead. For example, this is a regression model: $y = \beta_0 + \beta_1 x_1 + \epsilon$.

Mathematical notation

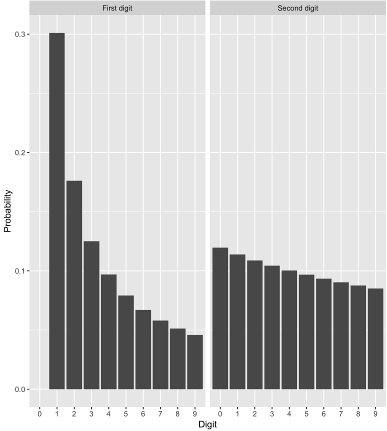
This is the equation environment:

$$P(D_2 = d_2) = \sum_{d_1=1}^{9} \log\left(1 + \frac{1}{10\,d_1 + d_2}\right), d_2 \in \{0, \ldots, 9\} \qquad (1)$$

Note that with the equation environment equations are numbered.

including pictures

This picture is in the “figures” folder:



Multinomial $\wedge$ Dirichlet Model

- Bayesian model selection:
  - Likelihood: $\boldsymbol{x}|\boldsymbol{\theta} \sim \mathcal{M}_k(N, \boldsymbol{\theta})$
  - Hypotheses: $H_0 : \boldsymbol{\theta} = \boldsymbol{\theta}_0$ vs $H_1 : \boldsymbol{\theta} \neq \boldsymbol{\theta}_0$
  - Prior: $\pi(\boldsymbol{\theta}|H_0) = 1_{\boldsymbol{\theta}_0}(\boldsymbol{\theta}_0)$ and $\boldsymbol{\theta}|H_1, \boldsymbol{\alpha} \sim \mathrm{Dir}_k(\boldsymbol{\alpha})$
  - Marginal density: $m_i(\boldsymbol{x}) = \int_{\Theta_i} f(\boldsymbol{x}|\boldsymbol{\theta})\pi(\boldsymbol{\theta}|H_i)\, d\boldsymbol{\theta}, \quad i = 0, 1$
    - $m_0(\boldsymbol{x}) = \frac{N!}{\prod_{i=1}^{k+1} x_i!} \prod_{i=1}^{k+1} {\theta_{0i}}^{x_i}$
    - $m_1(\boldsymbol{x}) = \frac{N!}{\prod_{i=1}^{k+1} x_i!} \frac{B(\boldsymbol{\alpha}+\boldsymbol{x})}{B(\boldsymbol{\alpha})}$
  - Bayes factor:

    $$B_{01}(\boldsymbol{x}) = \frac{m_0(\boldsymbol{x})}{m_1(\boldsymbol{x})} = \frac{\prod_{i=1}^{k+1} ({\theta_{0i}}^{x_i}) \prod_{i=1}^{k+1}[\Gamma(\alpha_i)]\Gamma[\sum_{i=1}^{k+1}(\alpha_i+x_i)]}{\Gamma(\sum_{i=1}^{k+1} \alpha_i) \prod_{i=1}^{k+1} \Gamma(\alpha_i+x_i)}$$
- Bayesian parameter estimation:
  - Prior: $\boldsymbol{\theta}|\boldsymbol{\alpha} \sim \mathrm{Dir}_k(\boldsymbol{\alpha})$
  - Posterior: $\boldsymbol{\theta}|\boldsymbol{\alpha}, \boldsymbol{x} \sim \mathrm{Dir}_k(\boldsymbol{\alpha} + \boldsymbol{x}) \rightarrow$ Mean, mode, credible intervals.

Binomial $\wedge$ Beta Model

- Bayesian model selection:
  - Likelihood: $x \sim \text{Bin}(N, \theta)$
  - Hypotheses: $H_0 : \theta = \theta_0$ vs $H_1 : \theta \neq \theta_0$
  - Prior: $\pi(\theta|H_0) = 1_{\theta_0}(\theta)$ and $\theta|H_1 \sim$ Beta(a,b)
  - Marginal density: $m_i(x) = \int_0^1 f(x|\theta)\pi(\theta|H_i)d\theta,\ i = 0, 1$
    - $m_0(x) = \binom{N}{x}{\theta_0}^x(1-\theta_0)^{N-x}$
    - $m_1(x) = \binom{N}{x}\frac{B(x+a, n-x+b)}{B(a,b)}$
  - Bayes factor: $B_{01}(x) = \frac{m_0(x)}{m_1(x)} = \frac{\theta_0(1-\theta_0)^{N-x}\,\Gamma(a)\,\Gamma(b)\,\Gamma(n+a+b)}{\Gamma(a+b)\,\Gamma(n+a-x)\,\Gamma(x+a)}$
- Bayesian parameter estimation:
  - Prior: $\theta \sim \text{Beta}(a, b)$
  - Posterior: $\theta|x \sim \text{Beta}(a + x, b + N - x) \rightarrow$ Mean, mode, credible intervals

References

Bayarri, MJ et al. (2012). Criteria for Bayesian model choice with application to variable selection. *The Annals of Statistics* **40**(3), 1550–1577.

Benford, F (1938). The law of anomalous numbers. *Proceedings of the American Philosophical Society* **78**(4), 551–572.

Berger, JO and M Delampady (1987). Testing precise hypotheses. *Statistical Science* **2**(3), 317–335.

Berger, JO and T Sellke (1987). Testing a point null hypothesis: the irreconcilability of p values and evidence. *Journal of the American Statistical Association* **82**(397), 112–122.

Delampady, M and JO Berger (1990). Lower bounds on bayes factors for multinomial distributions, with application to chi-squared tests of fit. *The Annals of Statistics* **18**(3), 1295–1316.

Fonseca, PMTd (2016). Digit analysis using Benford's law: a Bayesian approach. Master's thesis. ISEG Lisbon School of Economics and Management.

Hill, TP (1995). A statistical derivation of the significant-digit law. *Statistical science* **10**(4), 354–363.

Ley, E (1996). On the peculiar distribution of the US stock indexes' digits. *The American Statistician* **50**(4), 311–313.

References (cont.)

Liang, F et al. (2008). Mixtures of g priors for Bayesian variable selection. *Journal of the American Statistical Association* **103**(481), 410–423.

Newcomb, S (1881). Note on the frequency of use of the different digits in natural numbers. *American Journal of mathematics* **4**(1), 39–40.

Pericchi, L and D Torres (2011). Quick anomaly detection by the Newcomb—Benford law, with applications to electoral processes data from the USA, Puerto Rico and Venezuela. *Statistical Science* **26**(4), 502–516.

Scott, JG (2009). Bayesian adjustment for multiplicity. PhD thesis. Duke University.

Shaffer, JP (1995). Multiple hypothesis testing. *Annual review of psychology* **46**, 561–584.

Wasserstein, RL and NA Lazar (2016). The ASA's statement on p-values: context, process, and purpose. *The American Statistician* **70**(2), 129–133.

Westfall, PH, WO Johnson, and JM Utts (1997). A Bayesian perspective on the Bonferroni adjustment. *Biometrika* **84**(2), 419–427.