Corrections on "A Gentle Introduction to Empirical Process Theory and Applications" by Bodhisattva Sen

1. Page 16, Exercise (HW1), the hat sign in $\{\hat{f}_n\}$ can be removed to save some notations.

2. Page 19, Equation (7), the summation should be $\sum_{k=1}^{N}$ (instead of $\sum_{i=1}^{N}$).

3. Page 20, Exercise (HW1), it should be the entropy $\log N(\epsilon, \mathcal{F}_L, \|\cdot\|_\infty)$ (instead of the covering number $N(\epsilon, \mathcal{F}_L, \|\cdot\|_\infty)$) in both occurrences.

4. Page 21, Exercise (HW1), the function classes $\mathcal{F}+\mathcal{G}$ and $\mathcal{F}\cdot\mathcal{G}$ should be specified as summations and products of functions from $\mathcal{F}$ and $\mathcal{G}$, repspectively. The current notation is a bit misleading.

5. Page 33, Lemma 3.19 Hint, $\tilde{\theta}_n := \alpha\hat{\theta}_n + (1-\alpha)\theta_0$.

6. Page 36, line 2, maybe need a K factor in the first term, e.g.,

$$\sqrt{\log N(\epsilon, \mathcal{G}_n(R), L_1(Q_n))}\frac{K}{\sqrt{n}}\sup_{g\in\tilde{\mathcal{G}}}\|g-g_0\|_n + K\epsilon.$$

7. Page 36, Exercise (HW1), the distance/norm Q in the breaket number is not defined. Is it should be $L_1(Q_n)$?

8. Page 38, Theorem 3.24, using the argument in the proof, one can only obtain

$$\mathbb{P}(|Z-\mathbb{E}(Z)|>t) \le 2e^{-t^2/2\sum_{i=1}^n c_i^2}.$$

   To have a tighter result, we have to bound the difference $\Delta_i(x_1,\ldots,x_{i-1},x)$ more carefully, e.g., show that $B_i - A_i \le c_i$, where $A_i < \Delta_i(x_1,\ldots,x_{i-1},x) < B_i$. In the current proof $B_i - A_i$ is upper bounded by $2c_i$.

9. Page 40, some arugments are missing between bounding the difference term $g(x_1,\ldots,x_n) - g(x_1,\ldots,x_{i-1},x_i',x_{i+1},\ldots,x_n)$ and applying Theorem 3.24. Note that g is defined based on f and Z is defined as the superemum over $f\in\mathcal{F}$.

10. Page 41, line 3, the constant in the upper bound (which is 4) does not match that in Lemma 3.16 (which is $2\sqrt{6}$).

11. Page 79, Remark 7.1 first line, change VC indices to VC dimensions.

12. Page 98, proof of Proposition 8.2, first equation, would it be better to write $\mathbb{P}(Z \geq t) = \inf_{\lambda>0} \mathbb{P}(e^{\lambda Z} \geq e^{\lambda t}) \leq ...$?

13. Page 98, proof of Proposition 8.2, it says "it can be checked that for $z > -1$...". However the infimum is attained at $\lambda = \log(1+z)$. As $\lambda > 0$, we only need to consider $z > 0$, which also always holds as z is taken to be t/ν.

14. Page 99, proof of Proposition 8.2, last paragraph of the proof, is it necessary to introduce the extra variable s in $\gamma(s) := \sup_{\lambda\in[0,3)}(\lambda s - \psi(\lambda))$? Why not just use $\gamma(t)$?

15. Page 102, Example 8.9, "let $Z := n\|\mathbb{F}_n - F\|_\infty$". Moreover, why $\sigma^2 = 1/4$, or is it just an assumption on $\mathcal{F}$?

16. Page 103, Example 8.9, do we require $c_3 > 1/2$ instead of $c_3 > 0$?

17. Page 103, Example 8.9, some argument is missing for the scenario $0 < x < 2c_1$. Moreover, why we have an extra constant c_2 in the final upper bound?

18. Page 155, Theorem 12.6, $\mathbb{G}_n$ is not definied. We believe it is just the same as $\mathbb{P}_n$.

19. Page 155, proof of Theorem 12.6, in the introduction of $\tilde{\mathbb{M}}_n(h)$ and $\hat{h}$, we believe it should be $\mathbb{G}_n$ instead of $\mathbb{G}$.

20. Page 156, proof of Theorem 12.6, it should be $P(f_{n,g}f_{n,h}) - P(f_{n,g})P(f_{n,h}) \to \cdots = h^\top \mathbb{E}[\mathbb{G}(\dot{m}_{\theta_0}\dot{m}_{\theta_0}^\top)]h$.

21. Page 156, proof of Theorem 12.6, last sentence, $\tilde{\mathbb{M}}_n(h)$ converges weakly to $h^\top \mathbb{G}_n(\dot{m}_{\theta_0}) + 1/2 h^\top V h$ ….

22. Page 157, first equation, it should be $\tilde{\mathbb{M}}_n(h)$ instead of $\tilde{M}_n(h)$. Second line of same equation, missing a $n^{2/3}$ in the second term.

23. Page 157, second equation, second line, should use θ^* instead of θ_0 in all occurance (also in the definition of constant b at the end of this example.)

24. Page 158, we believe $\mathbb{E}(Z) = 0$ is assumed when calculating $\mathrm{Var}(Z)$.

25. Page 166, the equations under definition of $F(\lambda)$, it should be $\mathrm{Ent}\,(g(X)^2) = \lambda\mathbb{E}(Ze^{\lambda Z}) - \mathbb{E}(e^{\lambda Z})\log\mathbb{E}(e^{\lambda Z}) = \cdots$