Tsinghua-Berkeley Shenzhen Institute
Inference and Information
Fall 2017

Homework 1

YOUR NAME September 26, 2017

- **Acknowledgments:** This template takes some materials from course CSE 547/Stat 548 of Washington University: `https://courses.cs.washington.edu/courses/cse547/17sp/index.html`.

  If you refer to other materials in your homework, please list here.

- **Collaborators:** I finish this template by myself. If you finish your homework all by yourself, make a similar statement. If you get help from others in finishing your homework, state like this:
  - 1.2 (b) was solved with the help from _____.
  - Discussion with _____ helped me finishing 1.3.

You may use `enumerate` to generate answers for each question:

1.1. Type of commonly used notations. Use another `enumerate` to start generate answers for sub-questions:

(a) Use `$ $` to get an inline equation: $ab = ba$.

(b) Use `equation` to have equation in display math mode:

$$\frac{a+b}{2} \geq \sqrt{ab} \tag{1}$$

(c) Use `\eqref` to get reference for equations: (1) holds when $a \geq 0, b \geq 0$.

(d) Now we would some commonly used notations:

i. Use `\mathbb{P}, \mathbb{R}, \mathbb{E}` to type $\mathbb{P}, \mathbb{R}, \mathbb{E}$.

ii. Use `\mathcal{A}, \mathcal{X}, \mathcal{Y}` to type $\mathcal{A}, \mathcal{X}, \mathcal{Y}$.

iii. Use `\mathsf{x}, \mathsf{y}, \mathsf{z}` to type random variables $\mathsf{x}, \mathsf{y}, \mathsf{z}$. For simplicity, I have defined several macros so you could simply type `\rvx, \rvy, \rvz`. Don't forget `$ $`!

iv. Thanks to these macros, we could have $\mathbb{R}, \mathbb{E}[\mathsf{x}], \mathrm{Var}(\mathsf{y}), \mathbb{P}(A), \perp\!\!\!\perp$ by typing
`\reals, \E[\rvx], \Var(\rvy), \Prob(A), \independent`.

v. Remember that $P_{\mathsf{x}|\mathsf{y}}(x|y) \triangleq \mathbb{P}(\mathsf{x} = x|\mathsf{y} = y)$.

α) Writing $\mathbb{P}(x)$ is wrong. $\mathbb{P}$ should only operate on events.

β) x is a random variable, while x is a real number.

(e) You may find `https://en.wikibooks.org/wiki/LaTeX` useful.

(f) Writing LaTeX online may be easier for beginners:

i. ShareLaTeX: `https://www.sharelatex.com/`.

ii. Overleaf: `https://www.overleaf.com/`.

1.2. You may need aligned equations for your homework, here are several examples:

$$\begin{aligned}(a+b)^2 &= (a+b)\cdot(a+b)\\ &= a^2+ba+ab+b^2\\ &= a^2+2ab+b^2.\end{aligned}$$

$$\begin{aligned}&(a-b)^2\\ &= a^2-ba-ab+b^2\\ &= a^2-2ab+b^2.\end{aligned}$$

$$\begin{cases}(a+b)^2 = a^2+2ab+b^2,\\ (a-b)^2 = a^2-2ab+b^2.\end{cases}$$

1.3. Thanks to Lizhong, who stopped me when I was preparing your 1.3, 1.4, 1.5 and 1.6. So you don't have 1.3 now.