Problem 1

Examples of blackboard and calligraphic letters: $\mathbb{R}^d \supset \mathbb{S}^{d-1}$, $C \subset \mathcal{B}$. We usually reserve $\mathbb{R}$ for the real numbers, $\mathbb{N}$ for the natural numbers, $\mathbb{Z}$ for the integers, etc. These are defined through macros $\texttt{\bbR}$, $\texttt{\bbS}$, $\texttt{\cC}$, $\texttt{\cB}$, etc.

Examples of bold-faced letters, perhaps suitable for matrix and vectors:

$$L(x, \lambda) = f(x) - \langle \lambda, A x - b \rangle.$$  \hfill (1)

These are defined through macros $\texttt{\bfx}$, $\texttt{\bflambda}$, $\texttt{\bfA}$, $\texttt{\bff}$, etc. The inner product uses the $\texttt{\dotp}$ macro.

Example of a math operator:

$$\text{var}(X) = \mathbb{E}X^2 - (\mathbb{E}X)^2.$$  \hfill (2)

The $\texttt{\var}$ macro is defined using $\texttt{\DeclareMathOperator}$.

Example of references: the Lagrangian is given in Eq. (1), and Theorem 1 is interesting. If the references show up as question marks, check that the reference is valid, and then also just try running the \LaTeX compiler once or twice more.

Example of adaptively-sized parentheses: using the $\texttt{\Parens}$ macro,

$$\left( \prod_{i=1}^{n} x_i \right)^{1/n} + \left( \prod_{i=1}^{n} y_i \right)^{1/n} \leq \left( \prod_{i=1}^{n} (x_i + y_i) \right)^{1/n}.$$

(also have macros for $\texttt{\Braces}$, $\texttt{\Brackets}$, $\texttt{\Norm}$, etc.).

Example of aligned equations:

\begin{align*}
\Pr(X = 1 \mid Y = 1) &= \frac{\Pr(X = 1 \land Y = 1)}{\Pr(Y = 1)} \\
&= \frac{\Pr(Y = 1 \mid X = 1) \cdot \Pr(X = 1)}{\Pr(Y = 1)}.
\end{align*}  \hfill (2)

Example of a theorem:
Theorem 1 (Euclid). There are infinitely many primes.

Euclid’s proof. There is at least one prime, namely 2. Now pick any finite list of primes $p_1, p_2, \ldots, p_n$. It suffices to show that there is another prime not on the list. Let $p := \prod_{i=1}^{n} p_i + 1$, which is not any of the primes on the list. If $p$ is prime, then we’re done. So suppose instead that $p$ is not prime. Then there is prime $q$ which divides $p$. If $q$ is one of the primes on the list, then it would divide $p - \prod_{i=1}^{n} p_i = 1$, which is impossible. Therefore $q$ is not one of the $n$ primes in the list, so we’re done.

Here is a centered table:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>entries</td>
<td>in</td>
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<td>table</td>
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<tr>
<td>2</td>
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<td>entries</td>
<td>more</td>
<td>entries</td>
</tr>
</tbody>
</table>

Here is an unordered list:

- An item
- Another item

Here is an ordered list:

1. First item
2. Second item

Problem 2

Problem 3

Problem 4

Problem 5