Small Exercises 4

Multivariate Gaussian

These small exercises are meant to prepare the inverted classroom lecture. Keep your answers short: two or three sentences, sometimes even less, should suffice. The purpose is to shape or question your intuition, not your mathematical rigour.

Your solutions are submitted *online* in a form found under the link at the bottom of the page. The submission deadline is *before* the respective inverted classroom!

The homework exercise sheet is due later.

Problem 1: Why do we use the Cholesky decomposition for sampling and density estimation?

> Numerically stable density estimation. Efficient sampling since we already have $\boldsymbol{L}$.

Problem 2: Parts of the density function of a multivariate Gaussian can be interpreted as the Mahalanobis distance. What does this imply for the shape of the Gaussian?

> It is shaped as a sphere in multiple dimensions that can only be translated, scaled and rotated.

Problem 3: What is the interpretation for inverting the covariance matrix when evaluating the density function of a Gaussian?

> One of many possible explanations is the following: We need to transform the value at which we want to evaluate the density back into a white Gaussian where we can evaluate the density easily.

Problem 4: In the lecture we stated that the Gaussian distribution has the highest entropy. But doesn't the uniform distribution have the highest entropy?

> The uniform distribution has the highest entropy but we searched for the distribution with highest entropy with constraints on the mean and variance. So for distributions with fixed (and finite) mean and variance the Gaussian distribution has the highest entropy.

Problem 5: What does the MLE solution of a Gaussian remind you of?

> The way the variance and mean gets computed shares similarity with computing it with the equations for the first and second moment. Especially if you compute those expectations with Monte-Carlo estimation.