Comments by Johannes on the first draft

*Date: 2021-12-15*

**Overall comment:**

Nice title! I've added two analogies in order to be able to visualise the model selection problem and the role of symmetries. I've also added a reference that Philip Maini sent me about having multiple models that describe the same data equally well. This is reference 4 I think, and Ruth is a co-author here. I've also received some comments from Philip Gerlee which is professor in mathematical biology at Chalmers University of Technology (my old University). Could you please go through the comments by both Philip's and try to address them? \newline Comment by:Johannes,\newline Date: 2021-12-07.

**Overall comment for the intro:**

I've added two analogies with clear pictures that can be visualised by the reader. These are the ``the blind men and the elephant'' to describe model selection and the sunflower to introduce symmetries.\newline Comment by:Johannes,\newline Date: 2021-12-07.

**Comment 1:**

Old formulation: ``\textit{In terms of mechanistic modelling, this corresponds to the existence of multiple plausible explanations or hypotheses about the function of the studied system as the structure of every model encodes a specific mechanism.}''. I wrote an alternative in the orange text which is easier to visualise, and it is based on the figure from Himmelfarbs article about ``the blind men and the elephant''. \newline Comment by:Johannes,\newline Date: 2021-12-07.

**Comment 2:**

For example, if we were to rotate a sunflower its appearance would look the same. In other words, the appearance of the sunflower is \textit{rotationally invariant}, and rotations correspond to a symmetry of the sunflower. Also, properties that are conserved under the action of a symmetry are called \textit{invariants} and using these we can formulate conservation laws such as the statement ``a sunflower is rotationally invariant''. These play a vital role in theoretical physics where conservation laws capture the fundamental properties of the studied system in a theoretical formula \cite{gross1996role}}. \todo[inline,color=orange]{Old formulation: ``\textit{These objects describe conserved properties often referred to as \textit{invariants} and using these it is possible to formulate \textit{conservation laws} \cite{gross1996role} capturing the fundamental properties of the studied system in a theoretical formula.}''. I wrote an alternative in the orange text which is easier to visualise, and it is based on a sunflower. \newline Comment by:Johannes,\newline Date: 2021-12-07.

**Comment 3:**

Tying back to the elephant analogy in the intro!\newline Comment by: Johannes,\newline Date: 2021-12-07.

**Comment 4:**

Below, I added a few sentences on the statistical error model we assume. I don't know if it makes matters better or worse, but my hope was that this could satisfy the potential statisticians that might read the article!\newline Comment by: Johannes,\newline Date: 2021-12-07.

**Comment 5:**

Could you try to look at all comments by Philip Maini and Philip Gerlee please?\newline Comment by: Johannes,\newline Date: 2021-12-07