Title: Quantile-based inequality measures (**Research**)

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Project description:

Inequality curves and measures, such as the Lorenz curve and associated Gini coefficient (see [1] for a recent review), are commonly used to assess the economic health of a region or population demographic. For example, when applied to income data, a large Gini coefficient indicates a high degree of income inequality. Governments and organizations from the world seek interventions that, when implemented, may reduce the degree of inequality.

While it undoubtedly is the most common measure of inequality, the Gini coefficient is moment-based and as a consequence can be highly influenced by extreme outliers. Additionally, and somewhat unexpectedly, recent work found that the estimator of the Gini coefficient converges to normality extremely slowly for some highly skewed distributions that are often considered in income modelling (e.g. [2]). Therefore, when only sample data is available, standard inference procedures that assume normality may lead to unreliable findings. Several quantile-based measures of inequality have recently been introduced ([2],[3]) that are robust to outliers and, according to numerous simulations studies, have excellent statistical properties such as quick convergence to normality for many highly skewed distributions.

This project will have several aims. Firstly, the unreliability of the Gini coefficient in the presence of extreme outliers will be highlighted both via example and simulation. Comparisons with the existing quantile-based measures will be also be made. The findings will allow for a clear set of recommendations on the usage of the Gini coefficients and quantile-based measures that will be useful for practitioners. Secondly, convergence of the measures to normality will be theoretically explored, providing valuable insight into the statistical properties of the estimators. Finally, one of the quantile-based measures that is most analogous to the Gini coefficient is insensitive to the upper half of income earners. The final part of this project will introduce a new version of this measure that does not exhibit this deficiency yet remains robust to outliers and retains rapid convergence to normality. Throughout the project, the quantile-based measures will be implemented on real data sets for income and wealth for a range of countries. This in itself may be lead to useful insights on economic wealth that have not been seen with other measures.

Ideally, candidates for this project would have experience in statistical inference and R programming. This is a field in which there is still much work to do, and the ability to extend the work upon that which is outlined above is not in doubt. Chances of publications arising from the project are high.

Bibliography:
[1] Kleiber, C. 2005. The Lorenz curve in Economics and Econometrics. Technical Report 30. University of Dortmund, SFB 475.
[2] Prendergast LA, Staudte RG. Quantile versions of the Lorenz curve. Electronic Journal of Statistics. 10:1896-1926. 2016
[3] Prendergast LA, Staudte RG. A Simple and Effective Inequality Measure. American Statistician. 2018.