# Quantile Factor Models: Readme File for the Replication Codes

Liang Chen[1], Juan J. Dolado[2], and Jesús Gonzalo[3]

[1]*Peking University HSBC Business School, chenliang@phbs.pku.edu.cn*
[2]*Department of Economics, Universidad Carlos III de Madrid, dolado@eco.uc3m.es*
[3]*Department of Economics, Universidad Carlos III de Madrid, jgonzalo@est-eco.uc3m.es*

## 1    Software Requirement

- MATLAB (R2016b or newer version).

## 2    Replication Codes for the Simulations

- Main functions:
    - IQR.m: estimates the quantile factors and factor loadings using the IQR algorithm.
    - rq_fnm.m: implements the standard quantile regression.
    - nbpiid.m: estimates the number of factors in AFM using the information criteria of Bai and Ng (2002).
- Auxiliary functions:
    - smooth_eight.m: calculates the value of the eighth-order kernel function in SQR.
    - rsquare_a.m: calculates the adjusted $R^2$.
    - minindc.m: required by the function nbpiid.m.
    - seqa.m: required by the function nbpiid.m.
- Codes to replicate the simulation results:

- SIMU_DGP1.m: generates the simulation results in Table 1.

- SIMU_DGP2_M1.m: generates the simulation results for **M1** in Table 2.

- SIMU_DGP2_M2.m: generates the simulation results for **M2** in Table 2.

- SIMU_DGP2_M3.m: generates the simulation results for **M3** in Table 2.

- SIMU_DGP2_M1_OA.m: generates the simulation results for **M1** in Table S.1 of the Online Appendix.

- SIMU_DGP2_M2_OA.m: generates the simulation results for **M2** in Table S.1 of the Online Appendix.

- SIMU_DGP2_M3_OA.m: generates the simulation results for **M3** in Table S.1 of the Online Appendix.

- SIMU_DGP3.m: generates the graphs in Figure S.1 and Figure S.2 of the Online Appendix.

# 3 Replication Codes for the Empirical Application

- Datasets:
  - 2020-01.csv: This is the FRED-QD macro dataset used in our empirical application, which contains 248 quarterly macro series dating back to 1959Q1. It is constructed and maintained by Michael W. McCracken and Serena Ng at the Federal Reserve Bank of St. Louis. It can be downloaded from https://research.stlouisfed.org/econ/mccracken/fred-databases/. See McCracken and Ng (2020) for a detailed description of the dataset.
  - GDP.csv: quarterly real GDP growth rate of the US from 1947Q1 to 2019Q2.
  - CPI.csv: monthly consumer price index (CPI) of the US from 1947M1 to 2019M12.
- Main functions:
  - IQR.m: estimates the quantile factors and factor loadings using the IQR algorithm.
  - rq_fnm.m: implements the standard quantile regression.
  - nbpiid.m: estimates the number of factors in AFM using the information criteria of Bai and Ng (2002).
  - AR_forecast_new.m: generates forecast of $y$ using autoregressive models, where the

optimal lag length is chosen by BIC.

- AR_DI_forecast_new.m: generates forecast of $y$ using factor-augmented autoregressive models, where the optimal lag length is chosen by BIC.

- Auxiliary functions:

  - prepare_missing.m: gets rid of the series with missing values.

  - rsquare_a.m: calculates the adjusted $R^2$.

  - minindc.m: required by the function nbpiid.m.

  - seqa.m: required by the function nbpiid.m.

  - standard.m: required by the function nbpiid.m.

  - QuantileInterpolation.m: matches the quantiles of the skewed-t distribution.

  - .../azzalini/: contains functions that are needed to implement the density forecast.

- Codes to replicate the empirical results:

  - FREQ_QD_1.m: cleans the macro dataset, and estimates the number of factors using $PC_{P1}$ of Bai and Ng (2002) and the rank-minimization estimator at different quantiles. The results, stored in the matrix named TABLE3_1, correspond to the second column of Table 3 in the paper. **Note: please run this file first before running the following files.**

  - FREQ_QD_2.m: computes the adjusted $R^2$ of regressing each of the quantile factors on the 8 PCA factors. The results, stored in the matrix named TABLE3_2, correspond to the third to the last columns of Table 3 in the paper.

  - FREQ_QD_3.m: generates the forecasting results for the growth rate of GDP reported in Table 4 of the paper. The results are stored in the matrix named TABLE4_UPPER.

  - FREQ_QD_4.m: generates the forecasting results for the inflation rate reported in Table 4 of the paper. The results are stored in the matrix named TABLE4_LOWER.

  - FREQ_QD_5.m: generates the predictive scores of the density forecasts for the growth rate of GDP. The outputs are the graphs in Figure 1 of the paper.

  - FREQ_QD_6.m: generates the predictive scores of the density forecasts for the inflation rate. The outputs are the graphs in Figure 1 of the paper.

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# References

Bai, J. and S. Ng (2002). Determining the number of factors in approximate factor models. *Econometrica 70*(1), 191–221.

McCracken, M. and S. Ng (2020). FRED-QD: A quarterly database for macroeconomic research. Technical report, National Bureau of Economic Research.