

MATLAB Code for
“Improving the Numerical Performance of BLP Static and Dynamic
Discrete Choice Random Coefficients Demand Estimation”

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1 Software Requirement

The code calls the constrained optimization solver KNITRO in MATLAB using the TOMLAB interface, a 3rd-party optimization toolbox. Users need to purchase a KNITRO license (along with a TOMLAB license) directly from TOMLAB Optimization.

KNITRO can now be called directly from the MATLAB Optimization Toolbox using `ktrlink`. We post a version of our code that calls KNITRO directly from MATLAB (without TOMLAB interface) on the website:

<http://faculty.chicagobooth.edu/jean-pierre.dube/vita/MPEC%20code.htm>

By using `ktrlink`, users need to purchase KNITRO from Ziena Optimization, Inc. (www.ziena.com); users do not need to purchase the TOMLAB toolbox.

2 Main Script Files

The following script files are used to produce the Monte Carlo results reported in the paper.

- Table 1. `MonteCarlos_June5_2008_startvalues.m`
- Table 2. `runNevo_tight_loose_MPEC.m`
- Table 3 and 4. `MonteCarlos_2010_12_30_01.m`
- Table 5 and 6. For MPEC: `main_MPEC_sparse.m`
For NFP, use the code for Table 3 and 4.
- Table 7. Change the number of markets/products in the code used for Table 3 and 4
- Table 8 and 9. For MPEC: `DynamicBLP_2typeMPEC_MAD_price.m`
For NFP: `DynamicBLP_2typeNFP_MAD_price.m`

3 Implementation

Supplying Derivatives and Sparsity Patterns.

To see the exact syntax used to call KNITRO through TOMLAB, please refer to the function `runGMMPECTOMLAB.m`. The code is able to handle a reasonably large number of products and markets, and hence constraints. This fact is due primarily to the fact that the MPEC optimization problem (for BLP) is sparse. An important step in using the constrained optimization algorithm is to specify the sparsity pattern of the constraints.

In addition, we supply the analytic first-order and second-order derivatives:

- gradients of the MPEC GMM objective function: `GMMPEC_grad.m`
- Jacobian of the constraints: `GMMPEC_dc.m`
- Hessian of the MPEC GMM objective function, `GMMPEC_hess.m`
- Hessian of the constraints: `GMMPEC_d2c.m`

Large-Scale Problems.

For models with more than 5,000 market share equations (as in Table 5 and 6), users need to use sparse matrix representation for the constraint Jacobian, Hessian and their respective sparsity patterns. Sparse matrices are critical to economize on memory usage. We have successfully solved instances of BLP models with 30,000 market share equations (150 markets and 20 products) using 500 MB RAM and 50,000 market share equations (250 markets and 20 products) using 1.5 GB RAM. Please refer to the code used for Table 5 – 6.

Options for KNITRO 7.0.

The code was run successfully in 2010 and 2011 using the KNITRO solver (version 6.0.0) to produce Monte Carlo results reported in Table 1 to 9 in the paper. The following options need to be supplied if a newer version of KNITRO (7.0 or above) is used:

```
blasoption 0
linsolver 4
bar_directinterval 100000
```

Reference

Dubé, Fox and Su (2011): “Improving the Numerical Performance of BLP Static and Dynamic Discrete Choice Random Coefficients Demand Estimation”. Forthcoming at *Econometrica*.