Online Appendix for "Predicting and Understanding Individual-Level Choice Under Risk"

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Figure 1: RDU win rate over ML by quartiles of consistency scores with GARP and FOSD

The fraction of subjects for whom RDU is more complete than the best regularized regression, tree-based, and neural network models, as well as the overall best ML model (indicated by black horizontal lines). The x-axis groups subjects by quartiles of consistency scores with GARP and FOSD, following the methods of Nishimura et al. (2017) and Polisson et al. (2020). This score measures the amount by which each budget constraint must be relaxed in order to remove all violations of GARP and FOSD and it is bounded between 0 and 1. A score closer to 1 indicates stronger consistency with GARP and FOSD. The quartile ranges are [0,0.83), [0.83,0.95), [0.95,0.99), and [0.99,1].

Panel A: Model Classes Completeness against ML 1st 2nd 3rd 4th 1st 2nd 3rd 4th Restrictiveness RDU \$8.92% -		Average	RDU's win rate	RDU's win rate against ML by e^{**} quartiles				Absolute completeness difference between RDU and ML by e^{**} quartiles				
RDU 89.2% - - - - - - - - - - - - 16.6% Regularized Regressions 79.5% 85.1% 67.5% 87.4% 88.8% 97.0% 3.1% 7.5% 9.9% 18.0% 20.7% Tree-based Models 89.1% 70.1% 60.8% 67.4% 71.7% 80.6% -2.0% 0.6% 0.7% 0.8% 10.6% Neural Networks [83.3%, 89.9%] 71.6% 92.6% 79.6% 92.9% 88.8% 99.2% 8.7% 14.4% 16.8% 30.7% 14.4% Seaso 75.9% 89.6% 77.9% 90.8% 91.7% 98.3% 6.4% 11.5% 14.0% 21.3% 20.7% GLS 70.2% 87.1% 70.8% 90.0% 91.7% 98.3% 6.4% 11.5% 14.0% 21.3% 20.7% GLS 70.2% 87.1% 70.8% 90.0% 91.9% 10.6% 10.4% 15.9% 38.1% 20.7% Ridge [0.6% 87.0% 70.8%<	Panel A: Model Classes	Completeness	against ML	1st	2nd	3rd	4th	1st	2nd	3rd	4th	Restrictiveness
Regularized Regressions 79.5% 85.1% 67.5% 87.4% 88.8% 97.0% 3.1% 7.5% 9.9% 18.0% 20.7% Tree-based Models 89.1% 70.1% 60.8% 67.4% 71.7% 80.6% -2.0% 0.6% 0.7% 0.8% 10.6% Neural Networks 71.6% 92.6% 79.6% 92.9% 98.8% 99.2% 8.7% 14.4% 16.8% 30.7% 14.4% Panel B: Regularized regressions 75.9% 89.6% 77.9% 90.8% 91.7% 98.3% 6.4% 11.5% 14.0% 20.7% OLS 75.9% 89.6% 77.9% 90.8% 91.7% 98.3% 6.4% 11.5% 14.0% 20.7% OLS 70.2% 87.1% 70.8% 90.0% 90.0% 97.9% 10.6% 10.4% 15.9% 39.0% 20.7% Ridge 70.6% 87.1% 70.8% 90.0% 90.0% 97.9% 10.6% 10.4% 15.9% 38.1% 20.7% Image 70.6% 87.1% 70.8% 89.5% 9	RDU	89.2% [88.3%, 89.9%]	-	-	-	-	-	-	-	-	-	16.6%
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Regularized Regressions	79.5% [77.8%, 80.5%]	85.1%	67.5%	87.4%	88.8%	97.0%	3.1%	7.5%	9.9%	18.0%	20.7%
Neural Networks T1.6% 92.6% 79.6% 92.9% 98.8% 99.2% 8.7% 14.4% 16.8% 30.7% 14.4% Panel B: Regularized regressions Image: Constraint of the state of th	Tree-based Models	89.1% [88.3%, 89.9%]	70.1%	60.8%	67.4%	71.7%	80.6%	-2.0%	0.6%	0.7%	0.8%	10.6%
Panel B: Regularized regressions Lasso 75.9% 89.6% 77.9% 90.8% 91.7% 98.3% 6.4% 11.5% 14.0% 21.3% 20.7% OLS 70.2% 87.1% 70.8% 90.0% 97.9% 10.6% 10.4% 15.9% 39.0% 20.7% Ridge [57.7%, 74.6%] 87.0% 70.8% 90.0% 97.9% 10.6% 10.4% 15.9% 39.0% 20.7% Ridge 70.6% 87.0% 70.8% 89.5% 90.0% 97.9% 10.5% 10.2% 15.6% 38.1% 20.7% Panel C: Tree-based models 87.0% 77.5% 88.3% 86.3% 91.6% 2.4% 3.5% 2.4% 2.0% 12.4% Linear 86.6% 85.9% 77.5% 88.3% 86.3% 91.6% 11.8% 5.8% 3.7% 3.6% 5.4% SVR 85.7% 88.5% 80.4% 90.4% 87.9% 95.4% 3.5% 3.9% 2.9%	Neural Networks	71.6% $[68.8%, 73.7%]$	92.6%	79.6%	92.9%	98.8%	99.2%	8.7%	14.4%	16.8%	30.7%	14.4%
Lasso 75.9% 89.6% 77.9% 90.8% 91.7% 98.3% 6.4% 11.5% 14.0% 21.3% 20.7% OLS 70.2% 87.1% 70.8% 90.0% 97.9% 10.6% 10.4% 15.9% 39.0% 20.7% Ridge 70.6% $[58.2\%, 75.1\%]$ 87.0% 70.8% 89.5% 90.0% 97.9% 10.6% 10.4% 15.9% 39.0% 20.7% Panel C: Tree-based modelKeamS 85.9% 77.5% 88.3% 86.3% 91.6% 2.4% 3.5% 2.4% 2.0% 12.4% Image: Second Seco	Panel B: Regularized regressions											
OLS 70.2% $[57.7\%, 74.6\%]$ 70.6% $[58.2\%, 75.1\%]$ 87.1% 87.0% 70.8% 90.0% 90.0% 90.0% 97.9% 10.6% 10.4% 15.9% 10.2% 10.2% 10.2% 10.2% 10.2% 	Lasso	75.9% [74.2%, 76.9%]	89.6%	77.9%	90.8%	91.7%	98.3%	6.4%	11.5%	14.0%	21.3%	20.7%
Ridge 70.6% $[58.2\%, 75.1\%]$ 87.0% 70.8% 89.5% 90.0% 97.9% 10.5% 10.2% 15.6% 38.1% 20.7% Panel C: Tree-based modelsMean 86.6% $[85.6\%, 87.4\%]$ 85.9% 77.5% 88.3% 86.3% 91.6% 2.4% 3.5% 2.4% 2.0% 12.4% Linear 82.9% $[81.7\%, 84.0\%]$ 86.5% 81.3% 85.8% 87.5% 91.6% 11.8% 5.8% 3.7% 3.6% 5.4% SVR 85.7% 	OLS	70.2%	87.1%	70.8%	90.0%	90.0%	97.9%	10.6%	10.4%	15.9%	39.0%	20.7%
Panel C: Tree-based models Mean 86.6% 85.9% 77.5% 88.3% 86.3% 91.6% 2.4% 3.5% 2.4% 2.0% 12.4% [85.6%, 87.4%] [85.6%, 87.4%]	Ridge	[58.2%, 75.1%]	87.0%	70.8%	89.5%	90.0%	97.9%	10.5%	10.2%	15.6%	38.1%	20.7%
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Panel C: Tree-based models											
Linear 82.9% $[81.7\%, 84.0\%]$ 86.5% 81.3% 81.3% 85.8% 87.5% 91.6% 11.8% 5.8% 3.7% 3.6% 3.6% 5.4% SVR 85.7% 85.7% 88.5% 80.4% 90.4% 90.4% 87.9% 95.4% 3.5% 3.9% 3.9% 2.9% 3.5% 10.7% RF 88.0% $[87.2\%, 88.8\%]$ 79.9% 70.0% 78.7% 80.8% 90.3% 90.3% -0.1% 1.4% 1.5% 1.4% 1.7% 11.9%	Mean	86.6% [85.6%, 87.4%]	85.9%	77.5%	88.3%	86.3%	91.6%	2.4%	3.5%	2.4%	2.0%	12.4%
SVR 85.7% 88.5% 80.4% 90.4% 87.9% 95.4% 3.5% 3.9% 2.9% 3.5% 10.7% RF [84.8%, 86.6%] 79.9% 70.0% 78.7% 80.8% 90.3% -0.1% 1.5% 1.4% 1.7% 11.9% [87.2%, 88.8%] 29% 88.8% 29% 29% 3.5% 10.7%	Linear	82.9% [81.7%, 84.0%]	86.5%	81.3%	85.8%	87.5%	91.6%	11.8%	5.8%	3.7%	3.6%	5.4%
RF 88.0% 79.9% 70.0% 78.7% 80.8% 90.3% -0.1% 1.5% 1.4% 1.7% 11.9% [87.2%, 88.8%] [87.2%, 88	SVR	85.7% [84.8%, 86.6%]	88.5%	80.4%	90.4%	87.9%	95.4%	3.5%	3.9%	2.9%	3.5%	10.7%
	RF	88.0% [87.2%, 88.8%]	79.9%	70.0%	78.7%	80.8%	90.3%	-0.1%	1.5%	1.4%	1.7%	11.9%

Table 1: The completeness and restrictiveness of RDU versus ML models

The left column reports the average completeness of each model, as well the 95% confidence interval for average completeness, and the next column reports the win rate of RDU against each model (that is, the fraction of subjects for whom RDU is more complete). The next two blocks of four columns report the win rate of RDU against each model and its absolute completeness difference by quartiles of the consistency score with GARP and FOSD. The right column reports the restrictiveness of each model. Panel A reports the results for RDU and the three *families* of ML models—regularized regressions, tree-based, and neural networks. For regularized regressions and tree-based models, we report restrictiveness as weighted averages of the most complete model in the class for each subject. Panels B and C report the results for each regularized regression and tree-based model, respectively.



Figure 2: The individual-level completeness of RDU versus the most complete ML model by e^{**} quartile.

The four panels plot the completeness scores of all subjects for RDU and the best ML model. Panels refer to the quartile of consistency score; Panel (a) plots the subjects in the lowest quartile of e^{**} , Panel (b) the second quartile of e^{**} , and so on. The quartile ranges are [0, 0.83), [0.83, 0.95), [0.95, 0.99), and [0.99, 1]. Each plotted point represents a subject. The horizontal axes are the completeness of RDU, and the vertical axes show the completeness of the best ML model. Each axis also provides a marginal kernel density estimate of completeness scores approximated using a Gaussian kernel.

References

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- POLISSON, M., J. K.-H. QUAH, AND L. RENOU (2020): "Revealed Preferences over Risk and Uncertainty," *American Economic Review*, 110, 1782–1820.