The MATLAB code included in this folder fits simple subjective value models to the Effort Expenditure for Rewards task (EEfRT; Treadway et al., 2009). Please email Jessica Cooper at jessica.cooper@gmail.com if you spot any errors, have questions, or have suggestions for improvement.

File Descriptions

QC_behavior.m generates basic behavioral variables for each subject. The output for this script and required changes are described in the beginning of the script.

SVModel.m, SVModel_2parameter.m, and BiasModel.m are the wrappers for running the modeling code. This is where data filenames are entered and data is read in. These scripts each use an associated script to run the model (run_SVmodel.m, run_SVmodel_2parameter.m, and runBias.m).

SVModel.m runs the full model that includes parameters to scale both effort and probability. Output for this model is: s (subnum starting at 1), k, h, t, fit (negative LL), number of trials included, BIC.
The value function used in this model is: $SV = RP^h - kE$, where R is the reward amount, P is the probability, E is the amount of effort (.3 for low effort, 1 for high effort), and *h* and *k* are free parameters. Values are translated into probabilities of selecting each option using a Softmax equation. Free parameter t is inverse temperature.

SVModel_2parameter.m allows you to set the value of h on line 16 to a constant value. This script can be used to run a "reward-only" variant of the model (h=0, where probability is not incorporated into subject values), or the case where h is held to be 1 (h=1, probabilities are treated at face value without distortion, described in Cooper et al. (2019)). Output for this model is: s (subnum starting at 1), k, t, fit (negative LL), number of trials included, BIC.

BiasModel.m runs the baseline/null model that does not use any trial-wise information. This provides the maximum likelihood when there is a constant probability of choosing the low effort option. Output for this model is: s (subnum starting at 1), *a* (bias for low effort), fit (negative LL), number of trials included, and BIC.

Getting Started

- In each script (SVModel.m, SVModel_2parameter.m, and BiasModel.m) the location where you save the folder must be changed. Data file names are listed in "filenames_all"

- There are many different versions of the EEfRT with different output file formatting. Most versions have 1 line of column labels and 4 practice trials. These trials are removed for analysis. If you have a different header length or number of practice trials, change nHeader. Some output versions are tab delimited, while some versions are comma delimited. Verify that you have selected the correct delimiter "rawData = read_mixed_csv(fname,'\t')" or replace these lines with your preferred method of reading in your data.
- Check that data columns line up. Some versions of the EEfRT do not list the probability in the output files and must be read in separately or pasted in.
- These scripts are set to only fit models to the first 50 trials, and exclude any trials where RT = 0, indicating a timeout. If timeouts were defined in a different way, you will need to change this in each run script ("if rt > 0").
- Output for each model is saved in the Output folder

Important Notes

- If you have subjects who do not have any choice variability (i.e. select all one option), the SV model will provide different parameter values if it is run multiple times. We would recommend excluding these subjects from any analysis looking at associations with parameter values. Analyses looking at change in BIC or best-fitting model would not be affected.
- Though uncommon, sometimes stable parameter values are not able to be identified for a subject. Run each model a few times to verify that your parameters are consistent, and do not include participants in analysis if parameters are not reliably estimated.
- An inability to reliably estimate parameter values is especially common in incomplete data files or when a subject has multiple timeout trials, since these subjects have fewer trials included in the model fitting procedure. Please pay particular attention to these subjects to make sure you are getting consistent/stable parameter values.

References:

Cooper, J. A., Barch, D. M., Reddy, L. F., Horan, W. P., Green, M. F., & Treadway, M. T. (2019). Effortful goal-directed behavior in schizophrenia: Computational subtypes and associations with cognition. Journal of abnormal psychology, 128(7), 710.

Treadway, M. T., Buckholtz, J. W., Schwartzman, A. N., Lambert, W. E., & Zald, D. H. (2009). Worth the 'EEfRT'? The effort expenditure for rewards task as an objective measure of motivation and anhedonia. PloS one, 4(8), e6598.