Suggested Naming Conventions in ARK

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Abstract

Sharing of code is easier when similar objects in different modules have similar names. While we do not intend to enforce the recommendations in these guidelines, contributors trying to decide upon variable names will make their code more attractive to others by using names consistent with the advice herein.

Keywords ARK

JEL codes TBA

1 Principles

Our choices aim to balance a number of criteria:

- Brevity (nobody wants to type long names over and over)
- Uniqueness (in case you want to search-and-replace, the string should be unique)
- Mnemonic quality (it should be easy to remember what represents what)
- Ubiquity (objects defined herein will appear in many projects)
- Combinatoriality (easy to mix and match our recommendations)

2 Variables

2.1 Single-Letter

In a just universe, anyone who used a single Roman letter for a variable name would roast in search-and-replace hell for an eternity.

It is only slightly less boneheaded to name a variable after a letter in another commonly used alphabet (say, `delta`). Your future self (and other users) will not know which of the many possible meanings of δ you had in mind.

But brevity is a virtue. A single letter *in combination with a modifier or two* ('`cLvlMin`' as the minimum level of individual consumption, say) is fine – so long as the reader has some reason to expect that the letter `c` signifies the level of consumption of an individual.

That is the spirit in which we offer preferred interpretations for the Roman letters below. The upper case version generally should be interpreted as reflecting an aggregated version of the variable (at the level of the whole economy, or of the whole market being studied), while the lower case indicates the level of an individual consumer or firm or other entity.

When an alternative object with a meaning similar to, but distinct from, the definitions below is needed, please use a multi-letter name to represent it. For example, please do not use W for wealth (if some measure of wealth that differs from A, B, H, or N is needed); instead use, say, `Wlth` or `Wealth`.

A	-	*A*ssets *A*fter *A*ll *A*ctions *A*ccomplished
B	-	*B*eginning *B*ank *B*alances *B*efore any *B*ehavior (beginning-of-period)
C	-	*C*onsumption *C*hoice *C*onnects B to A
D	-	Debt
E	-	Labor *E*ffort
F	-	Production *F*unction
G	-	*G*rowth
H	-	*H*uman wealth
I	-	*I*nvestment
J	-	Ad*J*ustment costs (e.g., in a Q model)
K	-	Capital or beginning of period nonhuman assets
L	-	*L*abor supply
M	-	*M*arket resources (the sum of capital, capital income, and labor income)
N	-	*N*et wealth including human wealth ($= B + H$)
P	-	*P*ermanent noncapital income
Q	-	Hayashi/Abel Q (or similar asset price)
R	-	*R*eturn
S	-	Do NOT use for "saving" or "savings" or the "saving rate" – too confusing
T	-	*T*axes
U	-	*U*tility
V	-	*V*alue
W	-	*W*age
X	-	e*X*penditures (as distinct from consumption; e.g., for durables)
Y	-	Noncapital income (usually, the sum of transfer and labor income)
Z	-	Lei*Z*ure in consumption/leisure tradeoff

Table 1 Roman Letters

2.2 Strings

There are a few more objects that are likely to be used extensively in ARK projects than there are Roman letters. We present preferred usages here

Of course, contributors can use any of these for other purposes, but we prefer that a non-single-letter designation be used when an alternative is contemplated. For example, please do not use W for wealth (if some measure of wealth is needed); instead use, say, `Wlth` or `Wealth`.

Name	-	Description
`Cnd`	-	Consumption of nondurable good
`Cst`	-	Cost of something
`Dgd`	-	Stock of durable good
`Dvd`	-	Dividends
`Hse`	-	Quantity of housing (*not* value, which is quantity $\times$ price)
`Lbr`	-	Quantity of labor
`Perm`	-	Permanent income
`TaxAmt`	-	Quantity of tax paid (in, say, dollars or consumption units)
`TaxRte`	-	*ad valorem* tax rate applied to something (like interest)
`Tran`	-	Transitory income

Table 2 String Variables

3 Factors and Rates

When measuring change over time, lower-case variables reflect rates while the corresponding upper-case variable is the corresponding factor connecting adjacent discrete periods. (This convention rarely conflicts with the usage we endorse elsewhere of indicating individual-level variables by the lower and aggregate variables by the upper case).[1]

So, for example, if the annual interest rate is $\mathsf{r} = 0.03$ or three percent, then the annual interest factor is $\mathsf{R} = 1.03$.

We predefine the following factors:

We depart from the upper-lower case scheme when the conventional when the natural letter to use has an even more natural or urgent use elsewhere in our scheme. A particularly common example occurs in the case of models like Blanchard (1985) in which individual agents are subject to a Poisson probability of death. Because death was common in the middle ages, we use the archaic Gothic font for the death rate; and the probability of survival is the cancellation of the probability of death:

[1] If there is a need for the continuous-time representation, we endorse use of the discrete-time rate defined below. Any author who needs a continuous-time rate, a discrete-time rate, and a discrete-time factor is invited to invent their own notation.

Code	Output	Description
\Rfree	R	Riskfree interest factor
\rfree	r	Riskfree interest return
\Risky	$\mathbf{R}$	The return factor on a risky asset
\risky	$\mathbf{r}$	The return rate on a risky asset
\Rport	$\mathfrak{R}$	The return factor on the entire portfolio
\rport	$\mathfrak{r}$	The return rate on the entire portfolio

Table 3 Factors

Code	LaTeX	Description
\DieFac	$\mathfrak{D}$	Proportion who die
\LivFac	$\mathfrak{L}$	Proportion who do not die $= (1 - \mathfrak{D})$

Table 4 Special Cases: Factors and Rates

4 Parameters

Some parameters are worth defining because they are likely to be used in a high proportion of models; others are subject to enough constraints when used (such as the need for similar-looking upper- and lower-case Greek representations), as to be worth standardizing.

Programmers should use the corresponding variable name without the backslash as the name of the corresponding object in their code. For example, the Coefficient of Relative Risk Aversion is `\CRRA` in a LaTeX document and `CRRA` in a software module.

Mnemonics:

- Hebrew `daleth` is the fourth letter of the Hebrew alphabet (as d and δ are of the Roman and Greek) and is an etymological and linguistic cousin of those letters
- ω is the lower case Greek letter `omega`, because people say "OMG, I've got to think about the future."
- You are invited to scrutinize Ξ yourself to imagine reasons it could represent something to do with population growth.

5 Operators

A few operators are so universally used that it will be useful to define them.

6 Modifiers

The following are useful across many contexts:

Name	LaTeX	Description	Illustration
\CARA	α	Coefficient of Absolute Risk Aversion	$\mathrm{u}(\bullet) = -\alpha^{-1}e^{-\alpha\bullet}$
\CRRA	ρ	Coefficient of Relative Risk Aversion	$\mathrm{u}(\bullet) = (1-\rho)^{-1}\bullet^{1-\rho}$
\DiscFac	β	Time Discount Factor	$\mathrm{u}'(c_t) = \mathsf{R}\beta\mathrm{u}'(c_{t+1})$
\discRte	ω	Time Discount rate	$\beta^{-1} - 1$
\DeprFac	$\daleth$	Depreciation Factor (Hebrew daleth)	$K_{t+1} = \daleth K_t + I_t$
\deprRte	δ	Depreciation Rate	$\daleth = 1 - \delta$
\TranShkAgg	Θ	Transitory shock (aggregate)	$\mathbb{E}_t[\Theta_{t+n}] = 1$ if Θ iid
\tranShkInd	θ	Transitory shock (individual)	$\mathbb{E}_t[\theta_{t+n}] = 1$ if θ iid
\PermShkAgg	Ψ	Permanent shock (aggregate)	$\mathbb{E}_t[\Psi_{t+n}] = 1$ if Ψ iid
\permShkInd	ψ	Permanent shock (individual)	$\mathbb{E}_t[\psi_{t+n}] = 1$ if ψ iid
\PopGro	Ξ	Population Growth Factor	$L_{t+1} = \Xi L_t$
\popGro	ξ	Population Growth rate	$\Xi = 1 + \xi$
\PtyGro	Φ	Productivity Growth Factor	$G = \Phi\Xi$
\ptyGro	ϕ	Productivity Growth rate	$\Phi = (1 + \phi)$
\leiShare	ζ	Leisure share, Cobb-Douglas utility	$\mathrm{u}(c, z) = (1-\rho)^{-1}(c^{1-\zeta}z^{\zeta})^{1-\rho}$
\MPC	κ	Marginal Propensity to Consume	$\mathrm{c}'(m) = \partial c/\partial m$
\Pat	$\mathbf{Þ}$	Absolute Patience Factor (Thorn)	$\mathbf{Þ} = (\mathsf{R}\beta)^{1/\rho}$
\pat	þ	Absolute Patience rate (thorn)	$þ = (\mathsf{R}\beta)^{1/\rho} - 1 \approx \rho^{-1}(\mathsf{r} - \omega)$
\riskyshare	ς	Portfolio share in risky assets	$\mathfrak{R}_{t+1} = (1-\varsigma)\mathsf{R} + \varsigma\mathbf{R}_{t+1}$

Table 5 Parameters

Name	LaTeX	Description	Illustration
\Ex	$\mathbb{E}$	The expectation as of date t	$\mathbb{E}_t[\mathrm{u}'(c_{t+1})]$
\PDV	$\mathbb{P}$	Present Discounted Value	$\mathbb{P}_t^T(y)$ is human wealth

Table 6 Operators

Shocks will generally be represented by finite vectors of outcomes and their probabilities. For example, permanent income is called `Perm` and shocks are designated `PermShk`

Timing can be confusing because there can be multiple ordered steps within a 'period.' We will use `Prev`, `Curr`, `Next` to refer to steps relative to the local moment within a period, and t variables to refer to succeeding periods:

For testing and debugging purposes, it is useful to compare numerical values constructed by the code to analytical results available in some special cases. To distinguish the corresponding object in the two cases, we use

`Agg`	-	Value of something at the aggregate level (as opposed to `Ind`)
`Ind`	-	Value of something at the level of an individual (as opposed to `Agg`)
`Lvl`	-	Level
`Rto`	-	Ratio
`Bot`	-	Lower value in some range
`Top`	-	Upper value in some range
`Min`	-	Minimum possible value
`Max`	-	Maximum possible value
`Cnt`	-	Continuous-time value
`Dsc`	-	Discrete-time value
`Shk`	-	Shock

Table 7 General Purpose Modifiers

`Prbs`	-	Probabilities of outcomes (e.g. `PermShkPrbs` for permanent shock vector)
`Vals`	-	Values (e.g., mean one shock satisfies `PermShkVals` . `PermShkPrbs` = 1)

Table 8 Probabilities

[object]`tm1`	-	object in period t minus 1
[object]`tm2`	-	object in period t minus 2
[object]`Now`	-	object in period t
[object]`tp1`	-	object in t plus 1
[object]`tpn`	-	object in t plus n
[object]`Prev`	-	object in previous subperiod
[object]`Curr`	-	object in current subperiod
[object]`Next`	-	object in next subperiod

Table 9 Timing

`Anl`	-	The analytical result
`Num`	-	The numerical result

Table 10

References

Blanchard, Olivier J. (1985): "Debt, Deficits, and Finite Horizons," *Journal of Political Economy*, 93(2), 223–247.