Suggested Naming Conventions in ARK

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Abstract

Sharing of code is easier when similar objects across different contributions have similar names. While we will not enforce the recommendations in these guidelines, contributors can make their code more attractive to others by using names consistent with these guidelines.

Keywords ARK

JEL codes TBA

1 Principles

Our choices aim to balance these criteria:

- Brevity (nobody wants to type long names over and over)
- Uniqueness (in case you want to search-and-replace)
- 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

With a few exceptions articulated below, we strongly discourage contributors from using single-letter variable names. The many reasons for this advice are presented *ad nauseum* in introductory computer programming texts (which, we know, few economists consult), so we will not enumerate them here, except to point out that the extent to which your code will be influential depends upon the extent to which someone else can easily read it, which is harder if you have used variable names which could mean almost anything.

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 lower-case 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 is an aggregated version of the variable (at the level of the whole economy, say, or of the whole market being studied), while the lower case indicates the level of an individual consumer or firm or other subaggregate entity. Any exceptions to this rule are explicitly noted.

When an alternative is needed with a meaning similar to, but distinct from, the definitions below, 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`. (Some exemplars follow in a subsequent section).

Finally, some of the definitions below are prohibitions; these are based on many years of experience which have shown that use of the prohibited variable name generates more confusion than clarity.

A	-	*A*ssets *A*fter *A*ll *A*ctions have been *A*ccomplished (end of period)
B	-	*B*eginning *B*ank *B*alances *B*efore any *B*ehavior (*b*eginning-of-period)
C	-	*C*onsumption *C*hoice *C*onnects B to A
D	-	*D*ebt
E	-	PROHIBITED: Too many possible meanings (expectations, effort, expenses)
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	-	PROHIBITED: Is it Labor or Leisure or Land or ...?
M	-	*M*arket resources (the sum of capital, capital income, and labor income)
N	-	*N*et wealth including human wealth ($= B + H$)
O	-	PROHIBITED: Too similar to the number 0; too many possible meanings
P	-	PROHIBITED: Is it prices, permanent income, present value, profits, ...?
Q	-	Hayashi/Abel Q (or similar asset price)
R	-	*R*eturn (see the variants articulated below)
S	-	PROHIBITED: "saving" (flow)? or "savings" (stock)? or the "saving rate" (ratio)?
T	-	This is a tough one. See the discussion below.
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

The letter T is a special case. We reserve the capital letter to designate the end of the horizon (death, or the end of the economy, occurs at the end of period T). The lower case version t is so ubiquitiously used as the current time period that we do not want to resist the overwhelming force of tradition to prohibit its use in that capacity.

2.2 Strings

There are more objects that are likely to be used extensively in ARK projects than there are Roman letters. We present preferred usages for some of those commonly-needed variables here.

Name	-	Description
`Cnd`	-	Consumption of nondurable good
`Cost`	-	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
`Pop`	-	Size of population
`Tax`	-	Tax – should be modified by `Rte` or `Amt` articulated below
`Perm`	-	Permanent income
`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 connects adjacent discrete periods.[1,2] 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 depart from the upper-lower case scheme 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] 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.

[2] 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
\rport	$\mathfrak{r}$	The return rate on the entire portfolio
\RSave	$\underline{\mathsf{R}}$	Return factor earned on positive end-of-period assets
\rsave	$\underline{\mathsf{r}}$	Return rate earned on positive end-of-period assets
\RBoro	$\bar{\mathsf{R}}$	Return factor paid on debts
\rboro	$\bar{\mathsf{r}}$	Return rate paid on debts

Table 3 Factors and Rates

Code	LaTeX	Description
\DieFac	$\mathfrak{D}$	Probabilty of death
\LivFac	$\not{\mathfrak{D}}$	Probability to 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.

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

6 Modifiers

The following are useful across many contexts:

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:

[object]`Agg`	-	Value of something at the aggregate level (as opposed to `Ind`)
[object]`Ind`	-	Value of something at the level of an individual (as opposed to `Agg`)
[object]`Lvl`	-	Level
[object]`Rto`	-	Ratio
[object]`Bot`	-	Lower value in some range
[object]`Top`	-	Upper value in some range
[object]`Min`	-	Minimum possible value
[object]`Max`	-	Maximum possible value
[object]`Cnt`	-	Continuous-time value
[object]`Dsc`	-	Discrete-time value
[object]`Shk`	-	Shock
[object]`Trg`	-	The 'target' value of a variable
[object]`Rte`	-	A 'rate' variable like the discount rate ω
[object]`Fac`	-	A factor variable like the discount factor β

Table 7 General Purpose Modifiers

[object]`Prbs`	-	Probabilities of outcomes (e.g. `PermShkPrbs` for permanent shocks)
[object]`Vals`	-	Values (e.g., for mean one shock `PermShkVals` . `PermShkPrbs` = 1)

Table 8 Probabilities

[object]`tm2`	-	object in period t minus 2
[object]`tm1`	-	object in period t minus 1
[object]`Now`	-	object in period t
[object]`t`	-	object in period t (alternative definition)
[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

References

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