LaTex Code

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To Start

These notes contain the basic codes to start writing economic equations and formulas in Tex language. Each code is included in an easy and more complex example.

Containts

Greek letters

To write Greek letters the symbol of ***blackslash*** is followed by the name of the Greek letter.

Note that the symbol of ***blackslash*** is one of the main commands to write codes.

For example, some of the most used Greek letters in Economics:

```
$$
\begin{aligned}
  &\ \alpha \\
  &\ \beta \\
  &\ \gamma \\
  &\ \theta \\
  &\ \sigma \\
  &\ \rho \\
  &\ \lambda \\
  &\ \phi \\
  &\ \psi \\
```

```
  &\ \epsilon\\
\end{aligned}
$$
```

$$\begin{aligned}
&\ \alpha\\
&\ \beta\\
&\ \gamma\\
&\ \theta\\
&\ \sigma\\
&\ \rho\\
&\ \lambda\\
&\ \phi\\
&\ \psi\\
&\ \epsilon\\
\end{aligned}$$

For the corresponding capital letter, we just write in the same way but with initial capital letter.

Example

```
$$
\begin{aligned}
 &\ \Gamma \\
 &\ \Delta \\
 &\ \Sigma \\
 &\ \Lambda \\
 &\ \Omega \\
 &\ \Phi \\
 &\ \Psi \\
\end{aligned}
$$
```

$$\begin{aligned}
&\ \Gamma\\
&\ \Delta\\
&\ \Sigma\\
&\ \Lambda\\
&\ \Omega\\
&\ \Phi\\
&\ \Psi\\
\end{aligned}$$

Note: the codes:

```
$$
\begin{aligned}
  &\  \\
  &\  \\
\end{aligned}
$$
```

are used to align the test.

Parenthesis

We can write parenthesis and brackets just giving the input on the keyboard () or []. This does not work for braces.

Another way is to write parenthesis with the following notation:

```
$$
\left(
\right) \\
\left[
\right]
$$
```

$$\left(\right) \\ \left[\right]$$

that is writing the symbol of ***blackslash*** followed by ***left*** *before opening the parenthesis* and ***blackslash*** followed by ***right*** *before closing the parenthesis.*

In case of braces, we should use the following notation:

```
$$
\left\{
\right\}
$$
```

$$\left\{\right\}$$

The difference with respect to parenthesis and brackets is a *backslash after left and right.*

Example:

```
$$
10 \cdot
  \left\{
    5 + \left[
      3 + 2 \cdot
         \left(
            9-1\right)
        \right]
  \right\}
$$
```

$$10 \cdot \left\{5 + \left[3 + 2 \cdot \left(9 - 1\right)\right]\right\}$$

The opportunity to write the full notation for parenthesis and brackets will be clear when dealing whit fractions.

Fractions

To write fractions the inputs to give are ***backslash***, ***frac*** and then *numerator and denominator written between two braces.* With an example will be clear.

Example:

```
$$
\frac{5}{2}
$$
```

$$\frac{5}{2}$$

Example:

```
$$
\frac{\alpha}{1-\alpha} = \phi
$$
```

$$\frac{\alpha}{1-\alpha} = \phi$$

Paranthesis & Fraction

If we write a fraction in parenthesis with the shortcut

```
$$
( \frac{5}{2})
$$
```

$$(\frac{5}{2})$$

the parenthesis do not fit the fraction.

If we write with full notation

```
$$
\left(
  \frac{5}{2}
\right)
$$
```

$$\left(\frac{5}{2}\right)$$

we will have an appropriate result.

Example:

```
$$
\frac{Y}{L} =
  \left(
    \frac{K}{L}, 1
  \right)
$$
```

$$\frac{Y}{L} = \left(\frac{K}{L}, 1\right)$$

Exponential

To write the exponential we use the symbol of ***caret***

```
$$
2^5
$$
```

$$2^5$$

In case of operation in the exponential, we need to *use braces after the symbol of caret*

```
$$
2^{5-x}
$$
```

$$2^{5-x}$$

Example:

```
$$
F(K, L) =
  K^\alpha L^\beta
$$
```

$$F(K, L) = K^\alpha L^\beta$$

Example:

```
$$
F(K, L) =
   \left[
     \gamma K^\frac{\sigma - 1}{\sigma}
     + (1 - \gamma)L^\frac{\sigma - 1}{\sigma}   \right]^\frac{\sigma}{\sigma - 1}
$$
```

$$F(K, L) = \left[\gamma K^{\frac{\sigma-1}{\sigma}} + (1-\gamma)L^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

Subscript

To write subscript use the symbol of ***underscore***

```
$$
t_0
$$
```

$$t_0$$

We use *braces in case of operation in subscript*

Example

```
$$
y_ty_{t-j}
$$
```

$$y_t y_{t-j}$$

Derivative

Example:

```
$$
\frac{dk}{k}
$$
```

$$\frac{dk}{k}$$

To write partial differentiation, write the symbol of ***backslash*** followed by ***partial*** in the fraction notation

Example:

```
$$
\frac{
  \partial F}{
  \partial K}
   = r + \delta
$$
```

$$\frac{\partial F}{\partial K} = r + \delta$$

Lagrangian

The symbol of Lagrangian is written as follows:

```
$$
\mathcal L
$$
```

$$\mathcal{L}$$

Summation

The code to write summation is the symbol of ***backslash*** followed by ***sum***, ***underscore*** and *braces with lower bound of summation* followed by the symbol of ***caret*** *before the brace with the upper bound of summation.*

Example:

```
$$
\sum_{t_0}^{\infty}
$$
```

$$
\sum_{t_0}^{\infty}
$$

An example summing up what we saw until now:

```
$$
\mathcal L =
  \sum_{t=0}^{\infty}
    \left(
      \frac {1}{1 + \rho}
    \right)^{t} u(c_t)
      \frac{L_t}{H}
       + \lambda
        \left[
         S_0 + \sum_{t=0}^{\infty}
           R_t^{-1}w_t
            \left(
              \frac {L_t}{H}
            \right)
            - \sum_{t=0}^{\infty} R_t^{-1}c_t
              \left(
                \frac {L_t}{H}
              \right)
        \right]
$$
```

$$\mathcal{L} = \sum_{t=0}^{\infty} \left(\frac{1}{1+\rho} \right)^{t} u(c_t) \frac{L_t}{H} + \lambda \left[S_0 + \sum_{t=0}^{\infty} R_t^{-1} w_t \left(\frac{L_t}{H} \right) - \sum_{t=0}^{\infty} R_t^{-1} c_t \left(\frac{L_t}{H} \right) \right]$$

Limit

The code for limit is written as follows:

```
$$
\lim_{t\to\infty}
$$
```

$$\lim_{t \to \infty}$$

Example:

```
$$
\lim_
  {t\to\infty}
    R_t^{-1}S_t = 0
$$
```

$$\lim_{t \to \infty} R_t^{-1} S_t = 0$$

Example

```
$$
e^{
  lim_{\gamma\to0}
    \frac{1}{\gamma}ln
      \left[
        \alpha K^\gamma + (1 - \alpha)L^\gamma
     \right]}
$$
```

$$e^{lim_{\gamma\to0}\frac{1}{\gamma}ln[\alpha K^\gamma+(1-\alpha)L^\gamma]}$$

Integrals

```
$$
\int_0^\infty
$$
```

$$\int_0^\infty$$

Example

```
$$
\int_0^\infty
  \left[
    r(t)e^{-R(t)}S(t)
    + e^{-R(t)} w(t)
    \frac{L(t)}{H}
    -e^{-R(t)}c(t)
    \frac{L(t)}{H}
  \right]
  dt
$$
```

$$\int_0^\infty \left[r(t)e^{-R(t)}S(t) + e^{-R(t)}w(t)\frac{L(t)}{H} - e^{-R(t)}c(t)\frac{L(t)}{H} \right] dt$$

Matrix

The followin example shows how to write a matrix.

Note that ***bmatrix*** stands for *bracket matrix* while ***pmatrix*** stands for*parenthesized matrix*. Other kinds are available.

Moreover, ***vdots*** stands for *vertical dots* while ***ddots*** for *diagonal dots*. Other version of dots includes ***cdots*** that stands for *central dots*, used also as multiplication sign.

```
$$
A =
\begin{bmatrix}
  a_{11} & a_{12} & a_{13} & \dots & a_{1n} \\
  a_{21} & a_{22} & a_{23} & \dots & a_{2n} \\
```

```
  \vdots & \vdots & \vdots & \vdots & \vdots\\
  a_{m1} & a_{m2} & a_{m3} & \dots & a_{mn} \\
\end{bmatrix}
\ne
B =
\begin{pmatrix}
 b_{11} & b_{12} & b_{13} & \cdots & b_{1n} \\
 b_{21} & \ddots & b_{23} & \cdots & b_{2n} \\
 ...&...&... & \ddots &... \\
 b_{m1} & b_{m2} & b_{m3} & \dots & b_{mn} \\
\end{pmatrix}
$$
```

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & \dots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \dots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & a_{m3} & \dots & a_{mn} \end{bmatrix} \neq B = \begin{pmatrix} b_{11} & b_{12} & b_{13} & \cdots & b_{1n} \\ b_{21} & \ddots & b_{23} & \cdots & b_{2n} \\ ... & ... & ... & \ddots & ... \\ b_{m1} & b_{m2} & b_{m3} & \dots & b_{mn} \end{pmatrix}$$

Equalities and Inequalities

```
$$
\begin{aligned}
  &\ = \\
  &\ \neq \\
  &\ < \\
  &\ \leq \\
  &\ > \\
  &\ \geq \\
  &\ \simeq \\
\end{aligned}
$$
```

$$\begin{aligned} &= \\ &\neq \\ &< \\ &\leq \\ &> \\ &\geq \\ &\simeq \end{aligned}$$

Subset and Functions

```
$$
\begin{aligned}
  &\ \subset \\
  &\ \supset \\
  &\ \cap \\
  &\ \cup \\
```

```
  &\ \varnothing \\
  &\ \in \\
  &\ \ni \\
  &\ \notin \\
  &\ \exists \\
  &\ \forall \\
  &\ \to \\
  &\ \gets \\
  &\ \mapsto \\
  &\ \implies \\
\end{aligned}
$$
```

$$
\begin{aligned}
&\ \subset \\
&\ \supset \\
&\ \cap \\
&\ \cup \\
&\ \varnothing \\
&\ \in \\
&\ \ni \\
&\ \notin \\
&\ \exists \\
&\ \forall \\
&\ \to \\
&\ \gets \\
&\ \mapsto \\
&\ \implies
\end{aligned}
$$