Python - RTP manual

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1 Mathematical Description of main.py

The provided Python script processes weather data to calculate energy prices based on solar and wind energy dependencies. The mathematical operations are as follows:

1.1 Variables

The script uses the following variables:

- filepath: Path to the input weather data file.
- fileoutput: Path to the output CSV file where the results will be saved.
- $\text{base}^{\text{price}}$: Base price for energy calculations.
- $\text{min}^{\text{price}}$: Minimum price limit.
- $\text{max}^{\text{price}}$: Maximum price limit.
- α^{s}: Coefficient for solar energy dependency in price calculation.
- α^{w}: Coefficient for wind energy dependency in price calculation.
- α^{sd}: Coefficient for combined solar energy dependency in price calculation.
- α^{wd}: Coefficient for combined wind energy dependency in price calculation.
- n^{days}: Number of days to be used for calculating the moving average.
- GHI: Global Horizontal Irradiation data.
- WS: Wind Speed data.
- MA^{GHI}: Moving Average of Global Horizontal Irradiation.
- MA^{WS}: Moving Average of Wind Speed.
- NV^{GHI}: Normalized Variation percentage of Global Horizontal Irradiation.
- NV^{WS}: Normalized Variation percentage of Wind Speed.
- $\text{Price}^{\text{GHI}}$: Calculated price based on Global Horizontal Irradiation.
- Price^{WS}: Calculated price based on Wind Speed.
- $\text{Price}^{\text{Combined}}$: Calculated price based on combined solar and wind dependencies.

1.2 Equations

The mathematical equations used in the script are:

$$\text{wma} = \text{n}^{\text{days}} \times 24 \tag{1}$$

$$\text{MA}_t^{\text{GHI}} = \frac{1}{\text{wma}} \sum_{i=t-\text{wma}+1}^{t} \text{GHI}_i \tag{2}$$

$$\text{MA}_t^{\text{WS}} = \frac{1}{\text{wma}} \sum_{i=t-\text{wma}+1}^{t} \text{WS}_i \tag{3}$$

$$\text{NV}_t^{\text{GHI}} = \frac{\text{GHI}_t - \text{MA}_t^{\text{GHI}}}{\text{MA}_t^{\text{GHI}}} \tag{4}$$

$$\text{NV}_t^{\text{WS}} = \frac{\text{WS}_t - \text{MA}_t^{\text{WS}}}{\text{MA}_t^{\text{WS}}} \tag{5}$$

$$\text{Price}_t^{\text{GHI}} = \min(\max(\text{base}^{\text{price}} - \alpha^{\text{s}} \times \text{NV}_t^{\text{GHI}}, \text{min}^{\text{price}}), \text{max}^{\text{price}}) \tag{6}$$

$$\text{Price}_t^{\text{WS}} = \min(\max(\text{base}^{\text{price}} - \alpha^{\text{w}} \times \text{NV}_t^{\text{WS}}, \text{min}^{\text{price}}), \text{max}^{\text{price}}) \tag{7}$$

$$\text{Price}_t^{\text{Combined}} = \min(\max(\text{base}^{\text{price}} - \alpha^{\text{sd}} \times \text{NV}_t^{\text{GHI}} - \alpha^{\text{wd}} \times \text{NV}_t^{\text{WS}}, \text{min}^{\text{price}}), \text{max}^{\text{price}}) \tag{8}$$

2 Installation and Usage Manual

2.1 Installation

To run the provided Python script, follow these steps:

1. Enter the project directory or download it using the following command (make sure git is installed).

   ```
   git clone https://github.com/TeradaZenichi/real-time-pricing.git
   ```

2. Ensure you have Python installed on your system. You can download it from `https://www.python.org/`.

3. Install the necessary Python packages using a virtual environment:

(a) Create a virtual environment:

```
python -m venv myenv
```

(b) Activate the virtual environment:

- On Windows:

```
myenv\Scripts\activate
```

- On macOS and Linux:

```
source myenv/bin/activate
```

(c) Install the dependencies:

```
pip install -r requirements.txt
```

4. Save the provided Python script `main.py` and the configuration file `parameters.json` in the same directory.

2.2 Usage

To use the script, follow these steps:

1. Prepare your input weather data file. The script expects the file in a specific format, with columns for year, month, day, hour, global horizontal irradiation (GHI), and wind speed (WS).

2. Update the configuration file `parameters.json` with the appropriate paths and parameters. For example:

```
{
    "input file" :  "example/BEL_BRU_Brussels.Natl.AP.064510_TMYx.2007-2021.epw",
    "output file":  "prices.csv",
    "base price" :  1,
    "min price"  : -1e6,
    "max price"  :  1e6,
    "solar energy dependency" :         0.074,
    "wind energy dependency" :          0.120,
    "combined solar energy dependency": 0.074,
    "combined wind energy dependency":  0.120,
    "number of samples [day]":          7
}

```

3. Run the Python script:

```
python main.py
```

4. The script will process the input data and generate an output CSV file with the calculated energy prices.