EcxAnx Library

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1 Introduction

This document describes the methodoly used by the EcxAnx library.

2 Mathematical Foundations

2.1 Statistics

In the discrete world, given a random variable X, we can define the following operators:

$$\mathbb{E}[X] = \sum_{x \in X} x \mathbb{P}[X = x] \tag{1}$$

$$\mathrm{Var}[X] = \sum_{x \in X} (x - \mathbb{E}[X])^2 \mathbb{P}[X = x] \tag{2}$$

$$\mathrm{Cov}[X, Y] = \sum_{\omega \in \Omega} (X(\omega) - \mathbb{E}[X])(Y(\omega) - \mathbb{E}[Y]) \mathbb{P}[X = X(\omega), Y = Y(\omega)] \tag{3}$$

Given two samples $X = \{x_1, x_2, ..., x_n\}$ and $Y = \{y_1, y_2, ..., y_n\}$, one can also define the sample version of the previous operators:

$$\mathbb{E}[X] = \frac{1}{n} \sum_{i=1}^{n} x_i \tag{4}$$

$$\mathrm{Var}[X] = \frac{1}{n} \sum_{i=1}^{n} (x_i - \mathbb{E}[X])^2 \tag{5}$$

$$\mathrm{Cov}[X, Y] = \frac{1}{n} \sum_{i=1}^{n} (x_i - \mathbb{E}[X])(y_i - \mathbb{E}[Y]) \tag{6}$$

2.2 Time Series

A time series is a collection of data sorted, usually by date,

$$X = [x_1, x_2, ..., x_n]$$

Similarly to the previous operators one can define the autocovariance of lag k of a time series as

$$\mathrm{Cov}[X, \mathcal{L}^k X] = \frac{1}{n} \sum_{i=1}^{n-k} (x_i - \mathbb{E}[X])(x_{i+k} - \mathbb{E}[X]) \tag{7}$$

where we are assuming that the expectation of the lagged or trimmed time series is the same as the expectation of the time series itself