

# Application of Generative Models in Commodity Trading

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## Abstract

Abstract. Sample references: Ref 1 [1], ref 2 Jebara [2].

## 1 Introduction

Introduction, related works, business case

## 2 Related works

Related works

## 3 Methodology

Methodology

### 3.1 Stochastic differential equations

**Definition 3.1.** A stochastic process is a random variable of the form

$$X_t(\omega) : T \times \Omega \rightarrow \mathbb{R}$$

**Definition 3.2.** A stochastic process  $W = W_0, W_1, \dots, W_T$  is called a Wiener process if the following properties hold:

1.  $W_0 = 0$  with probability 1
2.  $\mathbb{E}W_t = 0$
3.  $\text{Var}[W_b - W_a] = b - a$  for all  $0 \leq a \leq b \leq T$
4.  $W_b - W_a \sim \mathcal{N}(0, b - a)$
5.  $W_b - W_a$  and  $W_d - W_c$  are independent for all  $a \leq b \leq c \leq d$

**Definition 3.3.** A stochastic differential equation is an equation of the form

$$dS_t = \mu S_t dt + \sigma S_t dW_t$$

where  $\mu$  and  $\sigma$  are some constants or some functions which represent the interest rate of nonrisky activities and is the market volatility respectively.

**Definition 3.4.** An Ito process is a stochastic process such that

$$X_t = X_0 + \int_0^t g(s)ds + \int_0^t h(s)dW_s$$

where  $g(t, \omega)$  and  $h(t, \omega)$  are random functions such that

$$P\left(\int_0^T |g(w, t)|dt < \infty\right) = 1 \text{ and } P\left(\int_0^T h(w, t)^2 dt < \infty\right) = 1$$

**Definition 3.5.** A diffusion process is the solution of SDE of the form

$$dX_t = b(t, X_t)dt + \sigma(t, X_t)dW_t$$

where some deterministic functions  $b$  and  $\sigma$  are called the *drift* and the *diffusion* coefficient of SDE such that

$$P\left\{\int_0^T \sup_{|x| \leq \mathbb{R}} (|b(t, x)| + \sigma^2(t, x))dt < \infty\right\} = 1$$

*A Black-Scholes-Merton or geometric Brownian motion*

**Definition 3.6.** The Black-Scholes-Merton is described by the stochastic differential equation of the form

$$dX_t = \theta_1 X_t dt + \theta_2 X_t dW_t, X_0 = x_0$$

with  $\theta_2 > 0$ . The parameter  $\theta_1$  represents the constant interest rate and  $\theta_2$  — the volatility of risky activities.

The explicit solution is

$$X_t = x_0 \exp\left\{\left(\theta_1 - \frac{1}{2}\theta_2^2\right)t + \theta_2 W_t\right\}$$

*B Cox-Ingersoll-Ross*

Cox-Ingersoll-Ross

## 3.2 Generative and Discriminative models

Generative and Discriminative models

*A Bayesian Inference*

Bayesian Inference

*B Support Vector Machines*

Support Vector Machines

*C Generative adversarial networks*

Generative adversarial networks

## 4 Case study

### 4.1 Dataset description

Dataset description

## 4.2 Data preprocessing

Data preprocessing

## 4.3 Model description

Model description

## 4.4 Model training

Model training

## 4.5 Quality metrics and results of testing

Quality metrics and results of testing

## 5 Conclusion

Conclusion

## References

- [1] Y. Chen, Y. Wang, D. Kirschen, and B. Zhang. Model-free renewable scenario generation using generative adversarial networks. *IEEE Transactions on Power Systems*, 33(3), 2018. doi: 10.1109/TPWRS.2018.2794541.
- [2] T. Jebara. *MACHINE LEARNING: Discriminative and Generative*. Kluwer Academic Publishers, 2004.