Interest Rate Modeling
Jaime Frade
Outline
Objective
Purpose
Background
Data
Regression Time series
ARIMA
CIR
European Call option

▲□▶ ▲圖▶ ▲国▶ ▲国▶ - 国 - の々ぐ

Jaime Frade

Outline

Objective

Purpose

Background

Data

Regression Time series

ARIMA

CIR

European Call

1 Objective

2 Purpose

3 Background

4 Data

- 3 month LIBOR
- 3 month T-rate
- 30 year T-rate

5 Regression Time series

Forcasted value

6 ARIMA

- Forcasted value
- 7 CIR
 - Forcasted value
- 8 European Call option

< ∃⇒

э

< 🗇 🕨

- 4 E b

Jaime Frade

Outline

Objective

Purpose

Background

Data

Regression Time series

ARIMA

CIR

European Call

The main focus of this project is to create a model for 3 month LIBOR interest rates. This will be modeled three different ways Regression Time Series

イロト イポト イヨト イヨト

3

Jaime Frade

Outline

Objective

- Purpose
- Background
- Data
- Regression Time series
- ARIMA
- CIR
- European Call option

The main focus of this project is to create a model for 3 month LIBOR interest rates. This will be modeled three different ways

- Regression Time Series
- ARIMA

イロト イポト イヨト イヨト

3

Jaime Frade

Outline

Objective

- Purpose
- Background
- Data
- Regression Time series
- ARIMA
- CIR
- European Call option

The main focus of this project is to create a model for 3 month LIBOR interest rates. This will be modeled three different ways

- Regression Time Series
- ARIMA
- Cox, Ingersoll, Ross (CIR) stochastic model.

- 4 同 6 4 回 6 4 回 6

Jaime Frade

Outline

Objective

Purpose

Background

Data

Regression Time series

ARIMA

CIR

European Call

The three models will be accessed and a short rate will be forecasted with some error. The forecasted rate will be used produce value of a European call option, with S, spot rate and K, strike price. The payoff for this call option is

 $\max[(S-K], 0)$

- 4 同 6 4 回 6 4 回 6

- Jaime Frade
- Outline
- Objective
- Purpose
- Background
- Data
- Regression Time series
- ARIMA
- CIR
- European Call option

The process for the short rate models a rate in a risk-neutral world. Interest rate behavior is similar to the behavior of stocks; however, rates appear to be pulled back to some long-run average level over time. This mean reversion is taken into consideration in only the CIR model.

- 4 同 6 4 日 6 4 日 6

- Jaime Frade
- Outline
- Objective
- Purpose
- Background

Data

- 3 month LIBO 3 month T-rate 30 year T-rate
- Regression Time series
- ARIMA
- CIR
- European Ca option

Interest rates were collected on a daily basis for the past three years. Data was obtained from the Federal Reserve website.

イロト イポト イヨト イヨト



Jaime Frade Interest Rate Modeling



Jaime Frade Interest Rate Modeling



æ

- Jaime Frade
- Outline
- Objective
- Purpose
- Background
- Data
- Regression Time series
- Forcasted value
- ARIMA
- CIR
- European Call option

To avoid multicollinearity, I regressed several models to predict either the current 3 month LIBOR rate or changes LIBOR rate. I decided to use a 1 step lag in the 3 month T-rate to predict Libor. **Model:**

$$Y = \beta_0 + \beta_1 * (X_{t-1})$$

イロト イポト イヨト イヨト

- Jaime Frade
- Outline
- Objective
- Purpose
- Background
- Data
- Regression Time series
- Forcasted value
- ARIMA
- CIR
- European Call option

Using a value of 1.5%, I predicted the 3 month LIBOR rate to be 4.55%, with a 95% confidence level (4.518720%, 4.585424%)

イロト イポト イヨト イヨト

- Jaime Frade
- Outline
- Objective
- Purpose
- Background
- Data
- Regression Time series

ARIMA

Forcasted value

European Call option ARIMA processes are just integrated ARMA processes. In other words, a process is ARIMA of order d if its d-th derivative is ARMA. The model can be written

$$\phi(B) (1-B)^d X_t = \theta(B) Z_t$$

イロト イポト イヨト イヨト

- Jaime Frade
- Outline
- Objective
- Purpose
- Background
- Data
- Regression Time series
- ARIMA

CIR

- Forcasted value
- European Cal option

A risk neutral process for r which contains a mean reverting drift as well as way to model non-negative rates. The change in the short rate in a short period of time is proportional to \sqrt{r} .

$$dr = a(b-r)dt + \sigma\sqrt{r}\,dz$$

イロト イポト イヨト イヨト

- Jaime Frade
- Outline
- Objective
- Purpose
- Background
- Data
- Regression Time series
- ARIMA
- CIR
- Forcasted value
- European Call option

Using Monte Carlo simulations and other assumptions about the parameters of the model, the following value for the LIBOR rate was forcasted. 4.5831179%

イロト イポト イヨト イヨト

- Jaime Frade
- Outline
- Objective
- Purpose
- Background
- Data
- Regression Time series
- ARIMA
- CIR
- European Call option

RTS model: Cost of 0.045600363 CIR model: Cost of option is 0.045892182

イロン イ団と イヨン イヨン

æ