



UNIVERSITY OF CAPE TOWN

PROJECT PROPOSAL

STA5069Z: Multivariate Statistics

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1 Introduction

In the South African financial industry it has become very important to be able to model and predict changes in interest rates as this impacts inflation levels and individuals' spending abilities. One of the main drivers of interest rates are bond prices as exists an inverse relationship between bond prices and interest rates. In this paper we analyze how PCA and Autoencoder methods succeed in describing the dynamics of South African bond market prices at different points in time ,especially in the proximity of major marker events.

1.1 Aim

This study aims to identify the main underlying factors that are responsible for driving South African interest movements using PCA and Autoencoders.

Moreover this analysis will be specifically made with the focus being on two periods where the South African financial market experienced volatility and extreme market stress. The first period will be 2008-2009 which is known to be the Global Financial Crisis(GFC) period which took a toll on individuals and institutions around the world, South Africa included. The second period will be 2015 which is called Nenegate in the financial industry- this is a period where South Africa's Minister of Finance Nhlanhla Nene was removed , causing havoc in the financial industry. Therefore this study further aims to identify the main drivers of interest rate movements during these two periods.

1.2 Hypothesis

The hypothesis is that using linear principal factor analysis and autoencoders we will find that a single common factor ,duration will drive a significant portion of variation in bond prices during the Global financial crisis ((2007-2009) and during Nenegate (2015) in South Africa.

2 Data Description

The data provides daily sampled bond market data; the data is daily sampled closing price data and runs from 1994 to 2017. This data was purchased from INET-BFA for academic use . The data consists of bonds with different maturities and types namely ALBI, 1 to 3 years bonds, 3 to 7 years, 7 to 12 years, over 12 years and GOVI.

3 Analysis Approach

The response variable , closing price will be used to determine the main drives bond price movements. The following variables will be used as the predictor variables: Duration, Convexity, Annualised Volatility, Interest Yield , BP (Basis Point Spread), Return YTD, Total Return Index, Total Return YTD, TRI (Total Return Index) Average Yield .

3.1 Methodology

3.1.1 Linear Principal Component Analysis

Linear PCA is one of the techniques used to project high-dimensional data into a lower-dimensional subspace by creating a reduced set of linear transformations of the input variables will be used to analyse the major drivers of South African financial bond market prices. Once complete one will be able to tell, among the multiple factors (e.g. duration, convexity or volatility etc.) which main factors mainly quantify the movement of yield curves and hence interest rates in the South African market.

3.1.2 Autoencoders

Among the machine learning and dimension reduction approaches, the autoencoder (AE) is a more current method for determining interest rates and also decrease the number of dimensions in the sample data. In this case we will analyze the bond prices for SA and the goal will be to examine the features obtained from the AE model.

3.1.3 Descriptive Statistics

The graph below plots the bond prices from 2008 - 2017. The period 2008-2009 (GFC) note a decline in bond prices across all bond types and maturities. Furthermore we note also note a decline in bond prices in the latter part of 2015 (Nenagate). We will be to apply multivariate dimension reduction methods to these two periods.

