Finger Millet (Ragi) Market Price Prediction

Abstract

Agriculture is an important sector in the Indian Economy as it contributes around 16% of India's Gross domestic product (GDP)3. India is an Agriculture based country where 70% of its rural households still depend primarily on agriculture for their livelihood, with 82% of farmers being small and medium.
Global demand for food is anticipated to increase by 60% by 2050. Today, a great percentage of the world's population is fed by small-scale farmers, primarily from developing countries, using traditional methods and rudimentary farming practices2. The complex value chain ,lack of resources and connectivity adds to the agricultural inefficiency. There is a strong need for a wider package of yield optimizing and risk decreasing services for these small-scale farmers.
Hence there is a need to provide farmers with an effective technology and knowledge to yield better crops
Hence there is a need to provide small scale farmers with enough information so that they get the best price for the yield.

This document talks about predicting market price for Finger Millet. The same model can be used for different cereal and pulses as they have similar shelf period.

The bulk of the world's millet crop is produced by India, Nigeria, Niger, Mali, Burkina Faso, Chad, and China. Finger millet (*Eleusine coracana* (L.) Gaertn), little millet (*Panicum* sumatrense Roth ex Roem. & Schult.), foxtail millet (*Setaria italica* (L.) P. Beauvois) and proso millet (*Panicum miliaceum* L.) are most commonly found species among various millet varieties. In India, finger millet occupy the largest area under cultivation among the small millets. Finger millet stands unique among cereals such as barley, rye and oats with higher nutritional contents and has outstanding properties as a subsistence food crop.
This crop is quite easy to grow at altitudes higher than usual. It is used as a major substitute for rice among diabetic patients and also the diet conscious people. It is one of the few cereals that needn't be polished making it healthier than its counterparts. Finger millet is a rich source of calcium, iron, protein, fibre and other minerals and is a gluten-free food. The cereal has low-fat content and contains mainly unsaturated fat. It is easy to digest and does not contain gluten; people who are sensitive to gluten can easily consume finger millet. It is considered as one of the most nutritious cereals.

General Intro on Millets

Millets comprised of six major small-grained cereal crops, namely finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*), Kodo millet (*Paspalum scrobiculate*), proso millet (*Panicum miliaceum*), barnyard millet (*Echinochloa* spp.), and little millet (*Panicum sumatrense*), and all of them are known for their unique traits and nutritional values. Millets need very little water for their production and can be cultivated under non-irrigated conditions or in very low rainfall regimes (200–500 mm). Single crops such as rice and wheat might provide food security but their cost of production remains high, while millets account for

manifold securities including food, fodder, fibre, nutrition, health, environment and livelihood at minimal cost, making them the essential guardians of agricultural security.

It is rich in calcium (0.34%), dietary fiber (18%), phytates (0.48%), protein (6%–13%) minerals (2.5%–3.5%), and phenolics (0.3%–3%). Moreover, it is also a rich source of thiamine, riboflavin, iron, methionine, isoleucine, leucine, phenylalanine and other essential amino acids. The abundance of these phytochemicals enhances the nutraceutical potential of finger millet, making it a powerhouse of health benefiting nutrients. It has distinguished health beneficial properties, such as anti-diabetic (type 2 diabetes mellitus), anti-diarrheal, antiulcer, anti-inflammatory, antitumerogenic (K562 chronic myeloid leukemia), atherosclerogenic effects, antimicrobial and antioxidant properties.

Production Stats of Millets

In India, during Kharif 2018-19 it has covered 8.26 lakh ha. The major ragi growing states in India are Karnataka (4.51 lakh ha), Tamil Nadu (0.26 lakh ha), Orissa (1.14 lakh ha), Andhra Pradesh (0.23 lakh ha), Uttarakhand (1.09 lakh ha) and Maharashtra (0.81 lakh ha). According to the 2nd advance estimates for 2018-19, ragi production estimate was 1.32 million tonnes as against 1.96 million tonnes in 2017-18.

Ragi Production and Usage

Ragi produced in the state is mostly consumed and part of it is marketed in neighbouring Maharashtra. The main marketing season is from mid-January to April. Normally farmers sell in Agricultural Produce Market Committee (**APMC**) Yard / Regulated Market Committees (RMC), Shandis or at the farm gate. It is predominantly grown as a rain-fed crop in Kharif; to a small extent as a summer crop with irrigation. In the recent past, consumer awareness and preferences have brought about wider demand for the produce. It is a major ingredient in health drinks and infant supplements preparation.

Price Prediction on Millets (Proposed Solution)

Predicting Finger Millet prices will useful and decision making for farmers, agribusiness industries.
India is one of the largest countries in agriculture production, India needs efficient and reliable food price forecasting models.

The price behavior of a commodity plays a crucial role in farm-level crop production planning. We are attempting to forecast millet price using statistical time-series modeling techniques- Long Short Term Memory(LSTM) which in on Recurrent Neural Network(RNN) models. The forecasting performance of these models has been evaluated and compared by using common criteria such as mean absolute percentage error, Akaike Information Criteria (AIC) and Schwarz's Bayesian Information criterion (SBC). The data used in this study include the monthly wholesale price of millet from January 2006 to October 2019.

Data Collection, Pre-processing Data

Collected more than 15 years (2001 to 2019) of data from Data.gov.in (Indian government data website) on Ragi and other few millets. The data has State, District, Market, Commodity, Variety, Arrival Date, Min Price, Max Price, Model Price.

Variety it to quality of the millet it has (Normal, Medium, Fine, Other).

Sample Data - 2003

state	district	market	commodity	variety	arrival_date	min_price	max_price	modal_price
Andhra Pradesh	Anantapur	P. Ramacharyulu Park,RBZ	Ragi (Finger Millet)	Other	30/10/2003	0	0	6
Andhra Pradesh	Anantapur	P. Ramacharyulu Park,RBZ	Ragi (Finger Millet)	Other	25/11/2003	0	0	7
Andhra Pradesh	Chittor	Madanapalli	Ragi (Finger Millet)	Fine	15/10/2003	600	700	7
Andhra Pradesh	Chittor	Madanapalli	Ragi (Finger Millet)	Fine	18/10/2003	600	700	7
Andhra Pradesh	Chittor	Madanapalli	Ragi (Finger Millet)	Fine	21/10/2003	600	700	7
Andhra Pradesh	Chittor	Madanapalli	Ragi (Finger Millet)	Fine	22/10/2003	600	700	7
Andhra Pradesh	Chittor	Madanapalli	Ragi (Finger Millet)	Fine	23/10/2003	550	650	7
Andhra Pradesh	Chittor	Madanapalli	Ragi (Finger Millet)	Fine	27/10/2003	550	650	7
Andhra Pradesh	Chittor	Madanapalli	Ragi (Finger Millet)	Fine	30/10/2003	600	700	7
Andhra Pradesh	Chittor	Madanapalli	Ragi (Finger Millet)	Fine	04/11/2003	610	710	7
Andhra Pradesh	Chittor	Madanapalli	Ragi (Finger Millet)	Fine	06/11/2003	600	700	7

Data Pre-processing

Combined all the years of data files to one file. We're building two initial models on Min and Max Pricing, on a particular market (ex: Bengaluru) with the fine variety, and validating null values if there are any we are using Forward fill method with using frequency Date. Frequency Date helps to fill the missing dates, Forward fill method helps to fill the empty values with a previous date value.

Sample Pre-processed Data for Bangalore Market Min Price

	Arrival Date	variety	Min_price
0	2006-02-01	Fine	540.0
1	2006-02-02	Fine	540.0
2	2006-02-03	Fine	540.0
3	2006-02-04	Fine	540.0
4	2006-02-05	Fine	540.0

Scaling and Building Model

There are two basic types which we can solve the price prediction problem using Structural and Time-Series. Here we're using time-series with LSTM modelling. LSTM is a sequence

prediction problems which finds the patterns and solves the problem. It is also used to predicting sales to find patterns into the stock market exchange. it is found that for almost all of these sequence prediction problems, LSTMs have been observed as the most effective solution.

Brief Intro on LSTM

LSTM is a neural network model used to deal with time-series data. It can deal with exploding and vanishing gradient problems. A common LSTM unit is composed of a cell, an input gate, an output gate and a forget gate. The cell remembers values over arbitrary time intervals and the three gates regulate the flow of information into and out of the cell. Intuitively, the cell is responsible for keeping track of the dependencies between the elements in the input sequence. The input gate controls the extent to which a new value flows into the cell, the forget gate controls the extent to which a value remains in the cell and the output gate controls the extent to which the value in the cell is used to compute the output activation of the LSTM unit. There are connections into and out of the LSTM gates, a few of which are recurrent. The weights of these connections, which need to be learned during training, determine how the gates operate.

Traditional neural networks cannot remember more of the past, but only the recent past (short term memory) and this is considered as a shortcoming of these networks. Recurring neural networks (RNN) can fix this problem

Train, Test Split and Scaling Using MinMaxScaler

We're splitting the data into train and test. with the training data, we're scaling the values to 0,1 using MinMaxScaler.

MinMaxScaler helps to transform the data in such a manner that it has mean as 0 and standard deviation as 1. In short, it **standardizes the data**. Standardization is useful for data which has negative values. It **arranges the data into normal distribution.**

Sequence Generation

Time-Series data is a sequential data, because of the order matters. A time series is a sequence taken at successive equally spaced points in time.

Using Sequential data from Sequential Regressor (Keras Library) generating Sequence data. For Time-series sequence prediction, LSTM will work better for the sequence classification problem.

MSE, LSTM

Using error minimizing technique called Mean Squared Error with Optimizer Adam.
MSE techniques give a positive value, so the sum will not be zero.

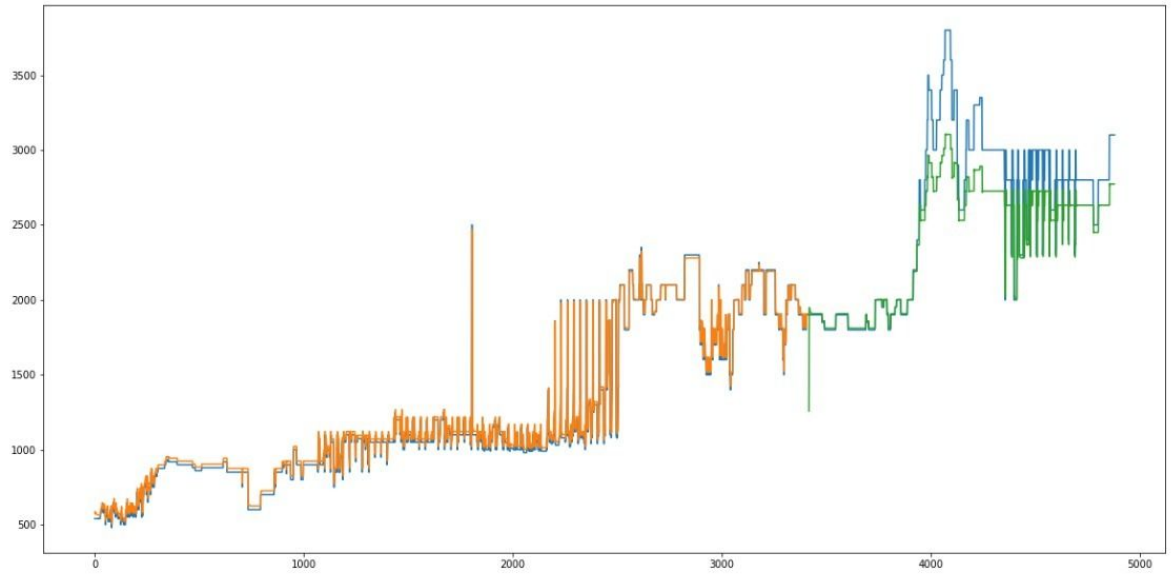
Adding LSTM dense layer increases features in other words A **dense layer** is just a regular **layer** of neurons in a neural network. Each neuron receives input from all the neurons in the previous **layer**, thus densely connected.

Will be training model with dense layer 1 epochs count 158. Epochs helps us to offer training data into smaller batches when training. it is important to know when all the training examples have been processed a single time.

And will be feeding the test data and predicting the results based on the training model and visualizing the data.

Visualizing the Data

With using a split of training 70% and test 30%, below are the results.



Challenges

Since the data is not available in one place we need to collate many sheets to get the desired data. Also since the data is not in the structured format we had to work a lot on the pre-processing.

Next Steps

We will be adding multiple cities and multiple millets, And using some accuracy methods to improve accuracy like adding LSTM layers, regularizers and/or dropout, adding epochs to balance with the batch size to avoid overfitting model.

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