# 2I2I ~ THE PROVABLY FAIREST AND MOST INCLUSIVE MARKET MODEL

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Abstract. This paper describes a novel, multi-dimensional, infinitely inclusive market model. The described model yields infinite types of new market dynamics and traditional markets as special cases, based on very few parameters. As the market allows any supply of arbitrarily small or large value to be traded in any currency, incl. subjective value currencies, any resulting liquid market must then find the fairest value of the supply.

## 1. Definitions

### 1.1. Market.

Assume we have a *seller* with a finite *supply* $\mathbb{S}$ and there exists a *demand* $\mathbb{D}$ consisting of *bid*s.

$$\mathbb{M}(\mathbb{S}, \mathbb{D}) = B$$

where $B \in \mathbb{D}$ is a *bid*.

More generally, we add a parameter to the *market* $\mathbb{M}$ to output the *bid* **next after** some given *bid* $B$.

$$\mathbb{M}(\mathbb{S}, \mathbb{D}, B) = B_{\text{next}}$$

$$B, B_{\text{next}} \in \mathbb{D} \cup \emptyset$$

$\emptyset$ represents an end, as follows. Simplifying $\mathbb{M}(\mathbb{S}, \mathbb{D}, B)$ to $\mathbb{M}(B)$,

$$\mathbb{M}(\emptyset) = B_{\text{first}}$$

$$\mathbb{M}(B_{\text{last}}) = \emptyset$$

This then allows for an ordering of the *bid*s

$$\mathbb{D} = [B_1, ..., B_{\text{N}}] = \left[\mathbb{M}^1(\emptyset), \mathbb{M}^2(\emptyset), ..., \mathbb{M}^N(\emptyset)\right] = [\mathbb{M}^{\text{rank}}\ (\emptyset)]_{\text{rank}=1}^N$$

### 1.2. Parameters.

The *seller* sets the following *parameters* $\mathbb{P}$:

$$\mathbb{P} = (\underline{\text{M}}, \mathbb{I})$$

$$\underline{\text{M}} \geq 0 \ \text{ minimum value of the supply}$$

$$\mathbb{I} = \text{importance}$$

The *importance* $\mathbb{I}$ will be explained later. It is a setting of the *seller* defining the importance of the different categories of *bid*s.

### 1.3. Bid.

Each *bid* $B$ looks as follows:

$$B = (T, A, \mathbb{P})$$

$$T = \text{time of creation}$$

$$A = (q, \text{ccy}, \text{FX}) \text{ is the amount of the bid}$$

$$\mathbb{P} = \text{ the sellers parameters at time } T$$

The *amount* $A$ contains a quantity $q$, a *currency* ccy and an exchange rate to a *base currency* FX, all fixed at time $T$.

### 1.4. Currency and FX.

Then

$$\mathbb{C} = \mathbb{C}_{\text{obj}} \uplus \mathbb{C}_{\text{subj}}$$

We choose some

$$\text{ccy}_{\text{base}} \in \mathbb{C}_{\text{obj}}$$

as the *base currency* and we define

$$\text{FX}(\text{ccy}) = \text{FX}(\text{ccy}, T) = \text{FX}(\text{ccy}, \text{ccy}_{\text{base}}, T)$$

as the *fair* exchange rate between ccy and $\text{ccy}_{\text{base}}$, i.e.

$$1[\text{ccy}] = \text{FX}(\text{ccy})[\text{ccy}_{\text{base}}]$$

and

$$\text{FX}(\text{ccy}) = \emptyset \text{ if } \text{ccy} \in \mathbb{C}_{\text{subj}}$$

Before we categorize the *bid*s, let's simplify them. First, we call a *bid* $B$ *objective*

$$B \text{ is objective} \Leftrightarrow \text{ccy} \in \mathbb{C}_{\text{obj}}$$

if it is of an objective value currency.

The *amount* $A$ of each *objective bid* can be transformed into the chosen *base currency*, as follows:

$$B(T, A = (q, \text{ccy}, \text{FX}), \mathbb{P}) \to B_{\text{base}}(T, A = (\text{FX} \cdot q, \text{ccy}_{\text{base}}, \text{FX} \equiv 1), \mathbb{P})$$

### 1.5. *Bid* Categories.

$$\text{chrony } (\textbf{CHR}) \Leftrightarrow B \text{ is objective and } q = \underline{M}$$

$$\text{highroller } (\textbf{HR}) \Leftrightarrow B \text{ is objective and } q > \underline{M}$$

$$\text{lurker } (\textbf{LURK}) \Leftrightarrow B \text{ is objective and } q < \underline{M}$$

$$\text{subjective } (\textbf{SUBJ}) \Leftrightarrow B \text{ is subjective}$$

We can denote a *bid* $B$'s *category* as $\text{BC}(B)$.

### 1.6. *Importance.*

The *seller* defines the *importance* per *bid category*

$$\mathbb{I} = (\mathbb{I}_{\text{CHR}}, \mathbb{I}_{\text{HR}}, \mathbb{I}_{\text{LURK}}, \mathbb{I}_{\text{SUBJ}})$$

where each *importace* is a natural number

$$\mathbb{I}_x \in \mathbb{N}_{\geq 0}, x \in \{\text{CHR}, \text{HR}, \text{LURK}, \text{SUBJ}\}$$

the market is activated

$$0 < \sum_x \mathbb{I}_x =: \sum \mathbb{I}$$

$$\mathbb{I}_{\text{LURK}} = 0$$

Amongst every subsequence of the ordered *bid*s $[B_n, ..., B_m]$ of length $\sum \mathbb{I}$, on average, we get $\mathbb{I}_x$ many of *bid category* $x$.

E.g. if

$$\mathbb{I} = (\mathbb{I}_{\text{CHR}} = 2, \mathbb{I}_{\text{HR}} = 3, \mathbb{I}_{\text{LURK}} = 0, \mathbb{I}_{\text{SUBJ}} = 1)$$

then, on average, any subsequence of 6 *bid*s *serviced* should contain 2 *chrony*, 3 *highroller bid*s and 1 *subjective bid.*

## 2. THE MARKET $\mathbb{M}$

### 2.1. **Characteristics.**

We want to create a *market* function such that:

- *importance* is respected
- internal category order is maintained
- the *seller* can use it's own subjective value function to value *subjective bid*s

### 2.2. **Internal category order.**

### 2.3. **Traditional *market*s as special cases.**

#### 2.3.1. *Fixed price.*

$$\underline{M} = \text{fixed price}$$

$$\mathbb{I} = (\mathbb{I}_{\text{CHR}} = 1, \mathbb{I}_{\text{HR}} = 0, \mathbb{I}_{\text{LURK}} = 0, \mathbb{I}_{\text{SUBJ}} = 0)$$

#### 2.3.2. *Auction.*

$$\underline{M} = \text{min price}$$

$$\mathbb{I} = (\mathbb{I}_{\text{CHR}} = 0, \mathbb{I}_{\text{HR}} = 1, \mathbb{I}_{\text{LURK}} = 0, \mathbb{I}_{\text{SUBJ}} = 0)$$

##### 2.3.2.1. *Barter.*

$$\mathbb{I} = (\mathbb{I}_{\text{CHR}} = 0, \mathbb{I}_{\text{HR}} = 0, \mathbb{I}_{\text{LURK}} = 0, \mathbb{I}_{\text{SUBJ}} = 1)$$

##### 2.3.2.2. *All other cases are mixed, innovative* market*s and can yield differing dynamics..*

### 2.4. **The algorithm.**

#### 2.4.1. *1. Sort the* bid*s.*

We can almost surely assume

$$T_i \neq T_j \text{ if } i \neq j$$

that the *bid*s can be sorted chronologically.

Given this chronological ordering, let's group the *bid*s by creating subsequences of constant *parameters*:

that is, changing the *parameters* $\mathbb{P}$ fixes the current order.

We are left with the task of ordering the *bid*s given constant *parameters* $\mathbb{P}$.

#### 2.4.2. *2. Decimal Importance.*

The *importance* $\mathbb{I}$ can be converted into decimals as follows:

$$\mathbb{I} \to \nu_x = \frac{\mathbb{I}_x}{\sum I} \in [0;1]$$

## 3. Notes

Call me Ishmael. Some years ago — never mind how long precisely — having little or no money in my purse, and nothing particular to interest me on shore, I thought I would sail about a little and see the watery part of the world. It is a way I have of driving off the spleen, and regulating the circulation. Whenever I find myself growing grim about the mouth; whenever it is a damp, drizzly November in my soul; whenever I find myself involuntarily pausing before coffin warehouses, and bringing up the rear of every funeral I meet; and especially whenever my hypos get such an upper hand of me, that it requires a strong moral principle to prevent me from deliberately stepping into the street, and methodically knocking people's hats off — then, I account it high time to get to sea as soon as I can. This is my substitute for pistol and ball. With a philosophical flourish Cato throws himself upon his sword; I quietly take to the ship. There is nothing surprising in this. If they but knew it, almost all men in their degree, some time or other, cherish very nearly the same feelings towards the ocean with me. [1]

There now is your insular city of the Manhattoes, belted round by wharves as Indian isles by coral reefs - commerce surrounds it with her surf. Right and left, the streets take you waterward. Its extreme down-town is the battery, where that noble mole is washed by waves, and cooled by breezes, which a few hours previous were out of sight of land. Look at the crowds of water-gazers there.

Anyone caught using formulas such as $\sqrt{x+y} = \sqrt{x} + \sqrt{y}$ or $\frac{1}{x+y} = \frac{1}{x} + \frac{1}{y}$ will fail.

The binomial theorem is

$$(x+y)^n = \sum_{k=0}^{n} \binom{n}{k} x^k y^{n-k}.$$

A favorite sum of most mathematicians is

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}.$$

Likewise a popular integral is

$$\int_{-\infty}^{\infty} e^{-x^2}\,\mathrm{d}x = \sqrt{\pi}$$

**Theorem 3.1.** *The square of any real number is non-negative.*

*Proof.* Any real number $x$ satisfies $x > 0$, $x = 0$, or $x < 0$. If $x = 0$, then $x^2 = 0 \geq 0$. If $x > 0$ then as a positive time a positive is positive we have $x^2 = xx > 0$. If $x < 0$ then $-x > 0$ and so by what we have just done $x^2 = (-x)^2 > 0$. So in all cases $x^2 \geq 0$. $\square$

## 4. Introduction

This is a new section.

### 4.1. Things that need to be done.

Prove theorems.

## 5. Background

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat voluptatem. Ut enim aeque doleamus animo, cum corpore dolemus, fieri tamen permagna accessio potest, si aliquod aeternum et infinitum impendere.

## References

[1] Astley, R., & Morris, L. (2020). At-scale impact of the Net Wok: a culinarically holistic investigation of distributed dumplings. *Armenian journal of proceedings*, 61, 192–219.

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