Tictak/Trusk-like Price Estimator

Version 1.0

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1 Overview

This document outlines the specifications for a Streamlit web application designed to provide instant price estimations for moving bulky items (e.g., furniture, appliances), inspired by the pricing models of Trusk and Tictak delivery services. The application calculates costs based on:

- Item details (volume, stair handling time, minimum truck size)
- Distance between pickup and delivery addresses
- Building floors at source and destination
- Truck size requirements
- Order urgency

The application provides a transparent cost breakdown and final total price, leveraging Python 3, Streamlit, and the Google Maps API for address validation and distance calculations.

2 Data Model

The application relies on a JSON file (`tictak.items.json`) that describes each item with the following fields:

Field	Type	Description
key	string	Unique item identifier (e.g., ”fridge”)
volume	float	Volume of one unit in m^3
min_truck_size	float	Minimum truck size (m^3) required for safe transport
stairTime	float	Average time in seconds to carry one unit across one floor

Table 1: Item Data Model

3 Input Parameters

The user provides the following inputs via the Streamlit interface:

- **Pickup address**: Validated using Google Geocoding API.
- **Delivery address**: Validated using Google Geocoding API.
- **Items & quantities**: Multi-select from the JSON dataset.
- **Source floors (down)**: Number of floors to descend at pickup.
- **Destination floors (up)**: Number of floors to climb at delivery.
- **Order type**: Either PLANNED (standard) or URGENT/Express.

4 Price Calculation

The total price is computed as:

$$\text{Total Price} = U \times [\text{Truck Fee} + \text{Distance Fee} + \text{Handling Fee}]$$

Where U is the urgency multiplier:

$$U = \begin{cases} 1.0 & \text{if PLANNED} \\ 1.5 & \text{if URGENT/Express} \end{cases}$$

4.1 Truck Fee

The truck fee is determined by the total volume (V) and the minimum truck size (T_{min}) required, with prices $p_{12} = 107.91\,€$ for a 12 m³ truck and $p_{20} = 129.31\,€$ for a 20 m³ truck:

- $V = \sum(\text{item.volume} \times \text{quantity})$ (total volume in m³)
- $T_{\text{min}} = \max(\text{item.min\_truck\_size})$

4.1.1 Case 1: Small Load

If $V \leq 12$ and $T_{\text{min}} \leq 12$:

$$\text{Truck Fee} = p_{12} = 107.91\,€$$

4.1.2 Case 2: Medium Load

If $V \leq 20$:

$$\text{Truck Fee} = \begin{cases} p_{20} = 129.31 & \text{if } T_{\text{min}} > 12 \\ \min(p_{20}, 2 \cdot p_{12}) = \min(129.31, 215.82) = 129.31 & \text{if } T_{\text{min}} \leq 12 \end{cases}$$

4.1.3 Case 3: Large Load

If $V > 20$:

$$\text{Truck Fee} = \min_{n_{20}, n_{12} \in \mathbb{Z}_{\geq 0}} (n_{20} \cdot p_{20} + n_{12} \cdot p_{12})$$

Subject to:

- Total capacity: $20n_{20} + 12n_{12} \geq V$
- If $T_{\text{min}} > 12$, then $n_{12} = 0$

Where:

- n_{20}: Number of 20 m³ trucks
- n_{12}: Number of 12 m³ trucks

This finds the cheapest combination of 12 m³ and 20 m³ trucks while respecting the total volume and minimum truck size constraints.

4.2 Distance Fee

A surcharge applies when the driving distance (D, in km) exceeds 15 km:

$$\text{Distance Fee} = \begin{cases} 0 & \text{if } D \leq 15 \\ 2.6 \times (D - 15) & \text{if } D > 15 \end{cases}$$

Distance is computed using the Google Distance Matrix API.

4.3 Handling Fee

The handling fee accounts for labor costs, depending on:

- Number of items (N)
- Total stair minutes (S)
- Floors at source (F_s) and destination (F_d)

4.3.1 Rate per Minute

The rate per minute ($r(N)$) increases with the number of items:

4.3.2 Stair Minutes

Stair minutes are calculated as:

$$S = \frac{1}{60} \times \sum_i \text{stairTime}_i \times \text{quantity}_i$$

Where stairTime_i is in seconds per floor per item.

Items (N)	Rate (€/min)
1–5	2.0
6–10	3.0
11–15	4.0
16–20	5.5
21–25	6.5
> 25	$7.35 + \left\lceil \frac{N-25}{5} \right\rceil$

Table 2: Rate per Minute

4.3.3 Floor Weighting

The handling multiplier accounts for heavier work at the destination:

$$M = 1 + F_s + 1.2 \times F_d$$

Where:

- F_s: Source floors (down)
- F_d: Destination floors (up)
- 1: Base loading/unloading allowance

4.3.4 Handling Fee Formula

$$\text{Handling Fee} = r(N) \times S \times M$$

5 Complete Formula

$$\text{Total Price} = U \times [\text{Truck Fee} + 2.6 \times \max(0, D - 15) + r(N) \times S \times (1 + F_s + 1.2F_d)]$$

6 Example Calculation

Consider the following scenario:

- **Items**: 1 Fridge (1.5 m³, 100 s stairTime), 2 Sofas (3 m³ each, 180 s stairTime)
- **Distance**: 22 km
- **Source floors**: 2
- **Destination floors**: 3
- **Order type**: URGENT/Express

6.1 Step 1: Volumes & Truck

$$V = 1.5 + (2 \times 3) = 7.5\,\text{m}^3$$

Assuming $T_{\text{min}} \leq 12$, Truck Fee = 107.91 € (Case 1: fits in one 12 m³ truck).

6.2 Step 2: Distance

$$D = 22 \quad \Rightarrow \quad \text{Distance Fee} = 2.6 \times (22 - 15) = 18.2\,€$$

6.3 Step 3: Handling

Total items: $N = 3$, so $r(N) = 2$ €/min.

Stair minutes:

$$S = \frac{1}{60}\left[(1 \times 100) + (2 \times 180)\right] = \frac{460}{60} \approx 7.67\,\text{min}$$

Multiplier:

$$M = 1 + 2 + 1.2 \times 3 = 1 + 2 + 3.6 = 6.6$$

Handling Fee:

$$2 \times 7.67 \times 6.6 \approx 101.24\,€$$

6.4 Step 4: Urgency

Urgency multiplier: $U = 1.5$.

6.5 Total

$$\text{Total Price} = 1.5 \times (107.91 + 18.2 + 101.24) \approx 340.73\,€$$

7 Application Workflow

The application follows these steps:

1. **User Input**: Collects address, items, floors, and urgency.
2. **Validation**: Verifies addresses via Google Geocoding API.
3. **Distance Calculation**: Uses Google Distance Matrix API to compute driving distance.
4. **Computation**: Applies formulas to calculate fees.
5. **Output**: Displays via Streamlit:
    - Pickup/Delivery details
    - Distance and volume
    - Item counts and stair minutes
    - Truck, distance, and handling fees
    - Urgency multiplier
    - Final total price