MASTER EQUATIONS

Full Financial Freight Pricing Model
Total Freight Rate=

$$\boxed{FreightCharge = (VariableCosts + OperationalCosts + StrategicAdjustments) \times (1 + Margin)}$$

Expanded:

Expanded:

$$\begin{aligned}\text{Total Freight Rate} = &[(\text{Miles} \times \text{Fuel CPM}) + \text{DEF} + \text{Tolls} + \text{Maintenance}] + \\ &[\text{Accessorials} + \text{Equipment Fees} + \text{Reefer Cost} + \text{Storage} + \text{Insurance}] + \\ &[\text{Risk Factor} + \text{Market Conditions} + \text{Deadhead} + \text{Seasonal Adjustments}] + \\ &[\text{Vehicle Payments} + \text{Office Overhead} + \text{Software Costs} + \text{Factoring Fees}] \\ &\times (1 + \text{Margin})\end{aligned}$$

Metric	Formula	Insight
Cost Per Mile	Total Cost ÷ Miles	Baseline operating efficiency
Revenue Per Mile (RPM)	Freight Rate ÷ Miles	Market competitiveness
Profit Per Mile	RPM – CPM	Profitability per lane
Break-Even RPM	Total Cost ÷ Miles	Minimum acceptable rate

SECTION 1: VARIABLE COSTS (Trip-Dependent Factors).

These are costs that change on every load, depending on distance, equipment, weather, fuel, and route conditions. They directly affect your Cost Per Mile (CPM) and Freight Rate Calculation

Cost of DEF (Diesel Exhaust Fluid)

Definition / Purpose

DEF is required for trucks with **SCR (Selective Catalytic Reduction)** systems to reduce emissions. It's consumed roughly at **2–3% of fuel usage**.

Impact on Freight Cost

It's a **consumable fluid** that adds to every trip cost. Though small compared to diesel, it accumulates over long hauls.

Formula

DEF Cost=(Total Fuel Used (gallons)×DEF Consumption Rate)×DEF Price per Gallon\text{DEF Cost} = (\text{Total Fuel Used (gallons)} \times \text{DEF Consumption Rate}) \times \text{DEF Price per Gallon}DEF Cost=(Total Fuel Used (gallons)×DEF Consumption Rate)×DEF Price per Gallon

Typical DEF Consumption Rate = 2.5% of fuel burned.
DEF Price = $3.00–$4.50/gal (varies by state or truck stop).

Example

- Trip: 1,200 miles
- MPG: 7
- Fuel Used = 1,200 ÷ 7 = **171 gal**
- DEF = 171 × 0.025 = 4.27 gal
- DEF @ $3.50 = 4.27 × 3.5 = **$14.95**

Add $15 to trip cost.

Integration

- Input DEF price manually or fetch from fuel API.
- Consumption rate linked to VIN or engine type.

Vehicle Maintenance

Definition / Purpose

Ongoing repair, oil, tire, and wear-and-tear expenses associated with mileage.

Impact

Affects the **cost per mile**—older or heavier vehicles cost more to maintain.

Formula

Maintenance Cost per Trip = Miles Driven×Maintenance Cost per Mile

$$\text{Maintenance Cost per Trip} = \text{Miles Driven} \times \text{Maintenance Cost per Mile}$$

Industry average:

- Light-duty: $0.10–$0.15/mi
- Medium-duty: $0.18–$0.25/mi
- Heavy-duty: $0.30–$0.45/mi

Example

Semi @ $0.35/mi × 1,200 miles = **$420**

Integration

- Pull from historical maintenance logs (per VIN).
- Option for AI to auto-adjust by vehicle age & usage.

Highway Tolls

Highway tolls are a **direct operational expense** that increases the cost per trip. They:

- Affect route selection (toll roads vs. toll-free routes)
- Impact **rate-per-mile (RPM)** and total trip cost
- Influence **carrier profitability and competitiveness**

Tolls can vary by:

- **Route and state** (e.g., I-95 in the Northeast, New York Thruway, Florida Turnpike)
- **Vehicle type and axle count**
- **Electronic pass vs. cash rate**
- **Trip frequency** (one-way vs. round-trip)

Tolls should be treated as a **pass-through expense** — meaning you charge the shipper the *exact* toll cost or include it in your rate.

We will use the Option A as its easier to Add the tolls from the API that will be provided for us

Also here We need to Show if here will be a ferry needed (We can not quote the amount but it will be needed for the User to be Aware)

Option A: Add as a Separate Line Item

Formula:

$$\text{Total Freight Charge} = (\text{Distance} \times \text{RPM}) + \text{Toll Cost}$$

Example:

- Route: Philadelphia, PA → Boston, MA
- Miles: 320
- RPM: $2.75
- Tolls: $95 (via I-95 corridor)

$$\text{Total} = (320 \times 2.75) + 95 = 880 + 95 = \$975$$

Option B: Blend into Your Rate per Mile

If you want to quote an **all-in RPM** (common for spot loads):

$$\text{All-in RPM} = \frac{(\text{Base Total} + \text{Tolls})}{\text{Miles}}$$

$$\text{All-in RPM} = \frac{880 + 95}{320} = 3.04$$

So, you would quote **$3.04/mile all-in** to the shipper.

Use APIs like **TollGuru**, **PC*Miler**, or Google Maps for automation.

Vehicle MPG (by VIN / Vehicle Type)

Definition

Miles per gallon (MPG) determines **fuel efficiency**.
Different trucks, engines, and loads produce different MPG.

Formula

$$\text{Fuel Used (gal)} = \frac{\text{Miles}}{\text{MPG}}$$

$$\text{Fuel Cost} = \text{Fuel Used} \times \text{Avg Fuel Price}$$

Example

- 1,200 miles
- MPG = 7.0
- Fuel @ $4.00/gal
  → Fuel Cost = (1,200 ÷ 7) × 4 = **$685.71**

Integration

- Pull real MPG data from VIN via API (e.g., NHTSA VIN decode + EPA dataset).
- Adjust dynamically for **weight, altitude, and weather** multipliers.

Weight of Load

Definition

Heavier loads **increase fuel consumption** and stress on drivetrain, brakes, and tires.

Formula (Fuel Impact)

For every **1,000 lb added**, MPG drops by about **0.5–1%**.

We can approximate:

$$\text{Adjusted MPG} = \text{Base MPG} \times \left(1 - \frac{(\text{Load Weight} - \text{Base Weight}) \times 0.0005}{1000}\right)$$

Simpler operational formula:

$$\text{Extra Fuel Cost} = \text{Miles} \times \text{Weight Factor} \times \text{Fuel Price per Mile}$$

where *Weight Factor* ≈ 0.0002 × (Weight in lb ÷ 1,000).

Example

- Base MPG = 8
- Load = 30,000 lb
- MPG Drop ≈ 15% → New MPG = 6.8
- Fuel @ $4.25/gal → Fuel Cost = (1,200 ÷ 6.8) × 4.25 = **$750**

Integration

- Weight is from manual input.
- Fuel estimator recalculates dynamically.

Load Type: Floor-Loaded vs Palletized

Type	Description	Impact	Typical Extra Cost
Floor-loaded	Freight stacked directly on floor, no pallets	More time to load/unload	+$50–$150
Palletized	Freight on pallets	Easier & faster	$0 extra

Formula

$$\text{Load Handling Fee} = \text{Base Fee} + \text{Type Adjustment}$$

Example

Base = $900, Floor-Loaded (+$75) → Total = **$975**

Straps and Binds

Definition

Additional tie-downs for flatbeds, box trucks, or cargo vans.

Impact

Extra cost when more than standard number of straps required.

Formula

\text{Strap Fee} = (\text{# of Extra Straps}) \times \text{Cost per Strap}

Example:
3 extra straps × $10 = **$30**

Please note that in cargo Van , Sprinter , Dry Van , reefer , the amount of straps and load bar a truck must have is 2- 3 industry standard . Anything more than 3 straps or load bad , or load lock must be charged for $10 per extra one

Distance

Definition

Total loaded + deadhead miles.
Core variable for every pricing model.

Formula

$$\text{Base Freight Rate} = \text{Miles} \times \text{Rate per Mile (RPM)}$$

$$\text{Profit per Mile} = \text{Revenue per Mile} - \text{Cost per Mile}$$

Example

- 1,200 miles @ $2.80/mi = $3,360
- Cost/mi = $2.20 → Profit = $720

Integration

- Auto-pulled from routing API (Google, HERE, or PC*Miler).
- Includes **deadhead** and **detours**. Ferry ride ETC

Expedite (Time-Sensitive Loads)

Definition

Loads requiring urgent pickup/delivery (same-day or overnight).

Impact

Higher rate due to priority scheduling, limited time, and team drivers.

Formula

$$\text{Expedite Premium} = \text{Base Rate} \times \text{Expedite Multiplier}$$

Typical Multiplier = 1.2 – 1.5× (20–50% higher) .

We will use 1.25 for industry standards (This should be set up when setting information in . They should be Advice that 1.25 is a good multiply but they can choose from 1.2 - 1.5)

Example

Base $3,000 × 1.25 = **$3,750**

Integration

- Toggle “Expedite = Yes” in the pricing screen.

- This version should calculate urgency factor from pickup/drop timestamps.
- Must take into consideration the log books of the driver if the run is possible or not . A team in Semi can run 1200 miles on a good day in 24 hrs . While Solo can run 600 miles ideally . But the average mile they do is 500 per day and 1000 per day .

Teams vs Solo

Definition

Team = 2 drivers rotating for continuous movement.
Solo = 1 driver limited by HOS (Hours of Service).

Impact

Teams move 40–60% faster, and cost more.

Formula

$$\text{Team Rate} = \text{Base Rate} \times (1 + \text{Team Premium})$$

Typical Premium: 0.25–0.35 (25–35%)

Example

Base $3,000 × 1.3 = **$3,900**

We will use 1.3 as industry standard (This should be set up when setting information in the beginning . They should be Advised that 1.3 is a good multiply but they can choose from 1.25 - 1.35)

Integration

- Use as a selectable option (Solo/Team).
- The system recalculates ETA + rate automatically.
-
- A team load is considered an Expedited load in 53 Ft Semi truck world so from settings if they are trying to price for a Semi truck they should see only Solo and team and Expedite option should not come up

White Glove

Definition

Special handling service — inside delivery, unpacking, assembly.

Impact

Applies mostly to **cargo vans, box trucks, sprinters**.

Formula

Flat rate from settings (e.g., $150–$300)

Example

White Glove = $200 flat

Total = Base + 200

Driver Assist

Definition

Driver helps in loading/unloading beyond basic responsibility.

Formula

Flat rate — typically $50–$100. Must be configured at the settings stage

Example

Base $900 + $75 = **$975**

Tracking (Internet / GPS Data Cost)

Definition

Ongoing cost of GPS or ELD connectivity for real-time visibility.

Formula

Flat micro-fee per trip = $3–$10.

This should be a flat fee and should be included at the setting

Special Equipment Needed

Definition

Tarps, liftgate, pallet jack, straps, etc.

Formula

$$\text{Special Equipment Fee} = \sum(\text{Equipment Needed} \times \text{Rental/Use Fee})$$

Example

Liftgate ($50) + Pallet Jack ($30) = **$80**

This should be a flat fee that should be included in the settings .

They can set from $20 - 70 and special Equipment fee

Weather

Definition

Weather affects **fuel, speed, safety, and time**.

Impact

- Cold → higher fuel (idle & viscosity)
- Rain/Snow → lower speed → more driver hours
- Wind → fuel inefficiency
- Storm delay → late delivery

Formula (Fuel Impact Example)

$$\text{Weather Multiplier} = 1 + (\text{Temperature Deviation Factor} + \text{Precipitation Factor})$$

$$\text{Adjusted Fuel Cost} = \text{Base Fuel Cost} \times \text{Weather Multiplier}$$

Approximate:

- Moderate rain/snow = +5–10% fuel - Use 8 %
- Severe weather = +15–25% total cost - Use 20 %
- Normal weather = 0 %

Example

Fuel $700 × 1.15 = **$805**

Integration

- Use live **OpenWeather API** for each route segment.
- Predict conditions during driver's ETA window.
- Multiply cost/time accordingly.

Season of the Year

Definition

Seasonality influences **demand, rates, and weather**.

Impact

Rates rise in high-demand seasons (e.g., harvest, holidays).

Formula

$$\text{Seasonal Adjustment} = \text{Base Rate} \times (1 + \text{Seasonal Factor})$$

Typical factor:

- Q4 Peak: +10–20%
- Off-season: −5–10%.

Do not Apply this formula Yet (They will get the season from the Wether)

This one should only notify them based on the calendar the general holidays during the time they will be hauling and they will need to make their own decision .

Once i can come up with Seasonal factor then we will add it at a future time because harvest is different in different times of the year and diffrent state

Altitude (Elevation)

Definition

Higher altitude = thinner air → lower engine efficiency → more fuel burn.

Formula

Each 1,000 ft increase reduces fuel efficiency by ~1–1.5%.

$$\text{Adjusted MPG} = \text{Base MPG} \times (1 - 0.01 \times \frac{\text{Avg Elevation (ft)}}{1000})$$

Example

Base MPG = 8
Avg Elevation = 5,000 ft → 5% drop → 7.6 MPG
Fuel = (1,200 ÷ 7.6) × $4.25 = $671.05

Integration

- **Use elevation data from Google Maps API for route points.**
- **Auto-adjust MPG estimate.**

SECTION 2: OPERATIONAL & SERVICE FACTORS

Distribution Center (DC) Pickup or Drop

Definition / Purpose

Large facilities like Walmart, Target, or Amazon DCs typically involve long waiting times for check-in, loading, or unloading.

Impact on Cost

- Higher **driver detention time**
- Lower **turnaround efficiency**
- Potential loss of hours for next load

Formula

$$\text{DC Fee} = \text{Base Rate} + (\text{Detention Hours} \times \text{Hourly Rate})$$

Average Detention Hourly = $25–$75/hr
Typical wait = 2–4 hours

Detention Hourly rate must be Set from the beginning Advice setting to be from $25 -$75

For Industry standard Apply $40 per hr

When calculating DC Fee , use Industry average of 2.5 hrs extra at pick up and Delivery . So it will be 2.5 x 40$

Example

4 hr wait × $40/hr = **$160**

Integration

- For now it wi;ll be added manually into the system . Later Auto-detect from pickup/drop name (“DC”, “Warehouse”, “Distribution”)
- Auto-apply detention multiplier

Reefer Load / Over-Sized Load

Definition

Reefer loads use **refrigerated units**, while over-sized loads exceed legal size/weight limits.

Impact

- Reefer: extra fuel + maintenance
- Over-sized: permits, escorts, and slower travel

Formula

{Extra Cost} = {Reefer Fuel Cost} + {Maintenance Fee} + {Permit & Escort Fees}

Average:

- Reefer fuel ≈ $0.05–$0.10/mi (Calculation will be shown below)
- Over-sized permit: $50–$300 per state **(This should not be added but be reminded . We need to tell them to charge the broker for the Over sized permit as this changes per state and also per provider and ability to get a permit .)**
- Escort: $1.50–$2.00/mi (**(This should not be added but be reminded . We need to tell them to charge the broker for the Over sized permit as this changes per state and also per provider and ability to get a permit .)**

Example

Reefer: 1,200 mi × $0.08 = **$96**
Over-sized: 2 states × $150 = **$300**

Cost of Operating a Reefer

Definition

The reefer unit burns fuel independently of the truck engine.
Average usage: **0.6–1.2 gallons/hr**

Formula

$$\text{Reefer Cost per Hour} = (\text{Fuel Used per Hour} \times \text{Fuel Price}) + \text{Maintenance Rate per Hour}$$

$$\text{Total Reefer Cost} = \text{Reefer Hours} \times \text{Reefer Cost per Hour}$$

Example:

- 1.0 gal/hr × $4.20 + $1/hr = $5.20/hr
- 15 hr trip = 15 × 5.2 = **$78**

Fuel cost should be aggregated via an Average of the drive location using API to know the fuel cost for that day

Maintenance cost in the Industry average is from $2 - $4 so we should advise that this is the range and that they should select the range from Settings . If they choose industry standard , let it be $2

Continuous vs Cycle (Reefer Mode)

Definition

- **Continuous** = Unit runs non-stop (for produce, frozen goods)
- **Cycle** = Turns on/off to maintain temp

Impact

Continuous uses **~30–40% more fuel**.

Formula

$$\text{Mode Adjustment} = \text{Base Reefer Cost} \times (1 + \text{Mode Multiplier})$$

Typical Multiplier:

- Continuous: +0.35
- Cycle: +0.00

Example

$78 × 1.35 = **$105.30**

Storage (Layover / Holding Freight)

Definition

If a truck must hold a load before final delivery, storage charges apply.

Formula

$$\text{Storage Fee} = \text{Daily Operating Cost} \times \text{Storage Days}$$

Where daily operating cost ≈ total fixed + variable CPM × avg daily miles. T

Example

$750/day × 2 days = **$1,500**

But we will use this for both

Storage fee and Layover fee can be Added after wards (So this comes later if the user has done the load and looking for how much to Add for storage or Layover

Its should be a flat rate set from the beginning and should only be Added if the user wants to Add it later on after the quote because they usually come after wards

Weekend / Extended Holding

Definition

If load must be held over a weekend or holidays.

Formula

$$\text{Weekend Fee} = \text{Daily Operating Cost} \times 1.25$$

(25% weekend premium)

Example

$750 × 1.25 = **$937.50**

Commodity Type

Definition

Different commodities have unique handling risks and insurance requirements.

Lets use an average of 1.25 for everything (For refrigerated loads we should charge just the reefer fee that was calculated above

Commodity Type	Impact on Rate	Typical RPM Adjustment
General freight	Base	0%
Electronics / High value	Increased security	+10–15% (Use 10 %)
Refrigerated perishables	Fragile & temp-sensitive	+10–20% (Use 10 %)
Hazmat / Chemicals/ Tanker endorsement	Special license & gear	+20–30%use 20 %
Military / Sensitive	Background checks	+25–35% use 20 %

Formula

$$\text{Commodity Premium} = \text{Base Rate} \times (1 + \text{Commodity Factor})$$

Example

Base $3,000 × 1.25 = **$3,750**

Endorsements Required

Definition

TSA, TWIC, Tanker, or Hazmat endorsements increase driver qualification level.

Formula

$$\text{Endorsement Fee} = \text{Base Rate} \times (1 + \text{Endorsement Multiplier})$$

This fee should be calculated with the one Above , If the commodity is Tanker , Hazmat , military ETC it should skip this step and should calculate based on what has been above

If there is any other endorsement needed like TSA then it should be calculated using this formula

Driver Risk / Security Premium

Definition

Added cost when the delivery involves high theft or accident risk zones.

Formula

$$\text{Risk Fee} = \text{Base Rate} \times (1 + \text{Risk Index})$$

Risk Index ranges:

- Low risk = 0.00
- Moderate = +0.05
- High = +0.10

(Combine with weather & location risk data.)

Data should come from API based on the state and region driver will be located using ZIP code

DOT / MC Licensing Costs

Definition

Regulatory compliance cost for maintaining licenses and authority.
Spread across trips as a small allocation.

Formula

$$\text{License Cost per Trip} = \frac{\text{Annual DOT/MC Costs}}{\text{Total Trips per Year}}$$

Example

$1,200 per year ÷ 240 trips = **$5 per trip**

License Plate Fees

Definition

Fixed cost distributed across operational mileage.

Formula

$$\text{Hotel Fee} = \text{Nights} \times \text{Avg Hotel Cost}$$

Example:
$1,600 ÷ 120,000 = $0.013/mi × 1,000 mi = **$13**

We will not use these formulas now . User should input from Settings how much they want to charge from $5 - $20 per load

US$5– 20/load depending on jurisdiction & weight class Should be suggested

Our Industry standard average should be $5 per load

Hotel Costs

Definition

For **day cabs, cargo vans, or sprinters** without sleepers. User should choose in settings if they have Sleeper or not

Formula

$$\text{Hotel Fee} = \text{Nights} \times \text{Avg Hotel Cost}$$

Avg hotel = $100–$150/night

Example

2 nights × $125 = **$250**

Dispatch & Backend (Overhead Fee)

Definition

Covers operational support — dispatchers, safety, accounting, compliance, etc.

Formula

$$\text{Backend Fee} = \text{Total Load Cost} \times 0.02$$

(Usually 1–2% of total cost.) We will use 0.02

Example

$3,000 × 0.02 = **$60**

Fuel (Variable Cost)

Definition

Core variable cost depending on route and MPG.

Formula (If load is within one State)

$$\text{Fuel Cost} = \frac{\text{Total Miles}}{\text{MPG}} \times \text{Avg Route Fuel Price}$$

Advanced Logic: If load crosses multiple states
If crossing multiple states → calculate weighted average:

$$\text{Avg Fuel Price} = \frac{\sum(\text{State Fuel Price} \times \text{Miles in State})}{\text{Total Miles}}$$

Use API: **EIA.gov**, **GasBuddy**, or **ProMiles**.

Insurance Costs

Definition

Fixed cost allocated across trips (liability, cargo, physical damage).

Formula (to know the over all cost per mile)

$$\text{Insurance per Mile} = \frac{\text{Annual Premium}}{\text{Annual Miles Driven}}$$

And to know per trip once we know the miles

$$\text{Insurance per Trip} = \text{Miles} \times \text{Insurance per Mile}$$

Example:
$12,000/yr ÷ 120,000 = $0.10/mi × 1,000 mi = **$100**

Semi truck: **120,000 miles/year (From 62k - 120 k per year average , we will use 120 k for our base mile when choosing industry standards)**

Box truck: **50,000 miles/year (From 45k to 60 k a year , we will use 50 k as a benchmark)**

Cargo/Sprinter van: **75,000 miles/year (From 60k to 100 k a year) We will use 75k as a benchmark**

Factoring Costs

Definition

Percentage paid to factoring companies for quick pay (financing fee).

Formula

$$\text{Factoring Fee} = \text{Invoice Amount} \times \text{Factoring Rate}$$

Typical rate: 1–4% (User needs to enter this % when doing the initial set up) Example:
$3,000 × 0.03 = **$90**

Vehicle Monthly Payment / Rental Cost

Definition

Fixed cost of truck financing or rental, spread by miles.

Since we know what our Yearly standard will be , we can divide by 12 and know what the Monthly will be . Also they should be Allowed to input their yearly mileage for those that know it

Formula

$$\text{Vehicle Cost per Mile} = \frac{\text{Monthly Payment}}{\text{Average Monthly Miles}}$$

Vehicle cost per Trip = Vehicle cost per Mile x Total miles for the trip

Example:
 $2,200 ÷ 10,000 = $0.22/mi × 1,000 mi = **$220**

Overhead (Load Board, Software, Office)

Definition

Tools used to find loads or manage fleets.

Formula (Do not use this formula)

$$\text{Overhead Fee per Trip} = \frac{\text{Total Monthly Overhead}}{\text{Trips per Month}}$$

We should do this instead

Overhead fee Per Mile = Total Monthly over head / Average miles per month

Over head per trip = Overhead per mile x Total miles for the trip

$$
\begin{aligned}
\text{Operational Cost} = &\text{DC Fee} + \text{Reefer/Oversize Cost} + \text{Storage or Weekend Fees} \\
&+ \text{Commodity Premiums} + \text{Endorsements} + \text{Risk Fees} + \text{Hotel} \\
&+ \text{Backend (Dispatch)} + \text{Factoring} + \text{Insurance per Trip} \\
&+ \text{Overhead (Software/Load Board)} + \text{Vehicle Payments}
\end{aligned}
$$

SECTION 3: STRATEGIC PRICING FACTORS

Deadhead Miles to Pickup

Definition / Purpose

Deadhead miles = distance traveled **without a paying load** (from current location to pickup point).
They are **pure cost** (fuel, time, wear) that must be built into your total rate.

Formula (No need to use adjusted RPM)

$$\text{Total Miles} = \text{Loaded Miles} + \text{Deadhead Miles}$$

$$\text{Deadhead Cost} = \text{Deadhead Miles} \times \text{Cost per Mile}$$

$$\text{Adjusted RPM} = \frac{\text{Total Revenue}}{\text{Total Miles}}$$

Example

- Pickup is 80 mi away
- Cost/mi = $1.90
  → Deadhead Cost = 80 × 1.9 = **$152**

Integration

- Auto-calculate via route API (driver location → pickup).
- Always included in the system's “effective miles.”

Location Strength (Good vs. Bad Market)

Definition

Some delivery zones have **strong outbound freight**, while others are **cold markets**.
Bad areas require **higher rates** to compensate for empty miles or poor reload potential.

Logic

- Good Market (Dallas, Chicago, Atlanta): Neutral or slight discount
- Bad Market (Montana, Maine, North Dakota): +10–25% adjustment

Formula

$$\text{Location Adjustment} = \text{Base Rate} \times (1 + \text{Market Index})$$

Where **Market Index =** rate differential between outbound & inbound freight.

Example:
Market Index = +0.15 → $3,000 × 1.15 = **$3,450**

Integration

- Requires API / data feed from **DAT RateView**, **Truckstop**, or **FreightWaves SONAR**.
- Use historical + real-time load-to-truck ratios.
- Algorithm compares origin & destination markets.

We need to start scrapping data and collecting them in our data base to start knowing how many loads are posted daily in every part of the USA and CANADA

Season of the Year

Definition

Seasonal supply-demand changes affect rates regionally (harvests, holidays, weather).

Season	Typical Trend	Adjustment
Winter	Harsh weather, lower capacity	+10–15%
Spring	Construction, reefer upturn	+5–10%
Summer	High freight demand	+15–25%
Fall	Peak holiday shipping	+20–30%

Formula

$$\text{Seasonal Factor} = \text{Base Rate} \times (1 + \text{Seasonal Percentage})$$

Example

$3,000 × 1.20 = **$3,600**

Integration

- Pull from **date of load**.
- Adjust automatically based on the seasonal lookup table.

We already have it calculated based on the weather condition . This should be used for Suggested rate and based on the season it should tell them typical trend but should not be Added to the rate , User can toggle Add to rate or not

Weather-Based Adjustments

Definition

Route weather influences **fuel consumption, delivery speed, and safety risk**.

Formula

$$\text{Weather Impact Multiplier} = 1 + (\text{Fuel Deviation \%} + \text{Delay \%} + \text{Risk \%})$$

Explanation

- **Fuel Deviation %** = extra fuel expected due to weather (wind, snow, storms, cold temperature, etc.)
- **Delay %** = expected slowdown or extra time added
- **Risk %** = added safety risk (ice, fog, visibility), applied as a cost factor

If weather adds:

- Fuel Deviation = **4%**
- Delay = **7%**
- Risk = **3%**

$$\text{Multiplier} = 1 + (0.04 + 0.07 + 0.03) = 1.14$$

Typical combined effect = 5–20% increase in total cost.

Example

Bad storm + wind = +0.15 → $2,000 × 1.15 = **$2,300**

Integration

- Use **OpenWeatherMap API** or **Tomorrow.io API**.
- Predicts fuel/time impact by route timestamp.
- Can feed into “Risk Assessment Score.

Risk Assessment (Global)

Definition

Evaluates the **overall safety, theft, and operational risk** of a trip based on:

- Route safety
- Theft data
- Weather severity
- Cargo type
- Driver hours & fatigue level

Algorithm (Concept)

$$\text{Risk Score} = \frac{(\text{Weather Risk} + \text{Location Theft Risk} + \text{Cargo Sensitivity})}{3}$$

$$\text{Risk Premium} = \text{Base Rate} \times \text{Risk Score}$$

Example

Risk Score = 0.08 → $3,000 × 0.08 = **$240 extra**

Integration

- Combine **FBI cargo theft database** + **route weather** + **driver hours**.
- Risk score between 0–1 (0 = safe, 1 = extreme).

Weight-Based Fuel Penalty (Extended)

Definition

Heavier loads = more drag = more fuel.
Already discussed in Section 1 but combined here for predictive modeling.

Formula

$$\text{Fuel Adjustment} = \text{Base Fuel Cost} \times (1 + 0.005 \times \frac{\text{Load Weight in 1,000s}}{10})$$

Example:
30,000 lb = +15% → $700 × 1.15 = **$805**

Market Demand Algorithm (Load-to-Truck Ratio)

Definition

Dynamic freight rate is strongly tied to **supply and demand** in each region.

Formula

$$\text{Market Rate Multiplier} = \frac{\text{Load-to-Truck Ratio}}{\text{Historical Average Ratio}}$$

$$\text{Dynamic Rate} = \text{Base Rate} \times \text{Market Rate Multiplier}$$

Example

- Current ratio = 6.0
- Historical avg = 4.0
  → Multiplier = 6 / 4 = 1.5
  $3,000 × 1.5 = **$4,500**

Integration

- Pull data from DAT, Truckstop, or FreightWaves SONAR API.
- Update every 15 minutes per region and equipment type.

Next “Money Lane” within 60 Miles

Definition

Predicts next profitable load zone near delivery (to reduce deadhead loss).

Logic

If the destination area has poor reloads, add a repositioning **premium**.

Formula

$$\text{Next Lane Adjustment} = \text{Base Rate} \times (1 + \text{Repositioning Factor})$$

Where:

- **Repositioning Factor** = function of distance to next load × demand strength.

Example

Next strong market = 80 miles away → +0.10 premium
$3,000 × 1.10 = **$3,300**

Integration

- Requires historical & live freight data.
- AI module analyzes lane history by equipment and season.

Load Type (Full vs. LTL)

Definition

- **Full Truckload (FTL):** Dedicated trailer, one shipper.
- **Less-Than-Truckload (LTL):** Shared trailer with multiple shipments.

Formula

$$\text{LTL Charge} = (\text{Total FTL Rate}) \times \frac{\text{Feet Occupied}}{\text{Total Trailer Feet}} + \text{Handling Fee}$$

Example

53 ft trailer
Load takes 12 ft → 12 ÷ 53 = 0.23
FTL $3,000 × 0.23 = $690

- Handling Fee $50 = **$740**

Note:
If load >50% of trailer → charge ¾ of full rate (since driver may not fit another load).

Dimension of Freight (Critical for Vans & Box Trucks)

Definition

Dimensions affect whether freight fits the vehicle (length, width, height).
Impacts available space and load pairing.

Formula

$$\text{Volume Used \%} = \frac{(\text{Length} \times \text{Width} \times \text{Height of Freight})}{(\text{Vehicle Cargo Volume})}$$

$$\text{Space Premium} = \text{Base Rate} \times \text{Volume Used \%}$$

Example:
Freight = 250 cu.ft, Cargo Van = 350 cu.ft
→ 71% of space used → $800 × 0.71 = **$568**

Integration

- User inputs or auto-detect from BOL.
- Validates if load fits before assigning to driver.

Weather Delay Risk + Season Overlap Logic (Combined AI Factor)

Definition

Combines **weather forecasts + seasonal trend data** to calculate potential delay cost.

Formula

$$\text{Delay Risk Index} = \frac{(\text{Weather Severity Score} + \text{Season Congestion Score})}{2}$$

$$\text{Delay Premium} = \text{Base Rate} \times \text{Delay Risk Index}$$

Example

0.10 index → $2,800 × 0.10 **= $280**

Integration

- Predicts potential slowdowns before pickup.
- Adjusts ETA and price dynamically.

Historical Lane Profitability Index

Definition

Uses previous loads' data to predict future profitability on a lane.

Formula

$$\text{Lane Index} = \frac{\text{Avg Profit per Mile (Lane)}}{\text{Avg Profit per Mile (All Lanes)}}$$

$$\text{Lane Multiplier} = \text{Base Rate} \times \text{Lane Index}$$

Example

If lane index = 1.15 → $3,000 × 1.15 = **$3,450**

Integration

- Internal CargoCredible database of all historical trips.
- Improves accuracy as system learns more routes.

Cross-Border or Customs Impact

Definition

Loads entering or exiting **Canada/Mexico** face customs delays and fees.

Formula

$$\text{Cross-Border Fee} = \text{Flat Rate} + \text{Delay Factor} \times \text{Base Rate}$$

Typical Fee: $150–$350 per crossing

Example

$200 + (0.05 × 3000) = **$350**

SECTION 4: FIXED & OVERHEAD COSTS

Fixed and overhead costs are **non-trip-dependent** expenses that keep the company running — whether or not a truck is moving.
These are distributed across all miles or trips to calculate a **true cost per mile (CPM)** and maintain profitability.

Insurance (Liability, Cargo, Physical Damage)

Definition

Mandatory coverage for trucks, trailers, and freight.

Formula

$$\text{Insurance CPM} = \frac{\text{Annual Premium}}{\text{Annual Miles}}$$

$$\text{Insurance per Trip} = \text{Miles} \times \text{Insurance CPM}$$

Example:
$14,400 / 120,000 mi = $0.12 / mi × 1,000 mi = **$120**

Vehicle Payment or Lease Cost

Definition

Truck financing or rental spread over miles.

Formula

$$\text{Vehicle CPM} = \frac{\text{Monthly Payment}}{\text{Monthly Miles}}$$

Example: $2,200 / 10,000 = $0.22 / mi × 1,000 mi = **$220**

Licensing, Permits & Compliance Fees

Definition

DOT, MC, IRP, IFTA renewals, UCR, etc.

Formula

$$\text{Compliance CPM} = \frac{\text{Annual Licensing Cost}}{\text{Annual Miles}}$$

Example: $1,200 / 120,000 = $0.01 / mi × 1,000 mi = **$10**

Office & Administrative Overhead

Definition

Office rent, dispatch salaries, internet, phones, utilities.

Formula

$$\text{Overhead per Trip} = \frac{\text{Monthly Overhead}}{\text{Trips per Month}}$$

or

$$\text{Overhead CPM} = \frac{\text{Monthly Overhead}}{\text{Monthly Miles}}$$

Example: $10,000 / 40 trips = **$250 per trip**

Software, Load Board, and Tech Tools

Definition

Subscriptions for load boards, ELDs, TMS, factoring portals, etc.

Formula

$$\text{Tech CPM} = \frac{\text{Total Monthly Subscriptions}}{\text{Monthly Miles}}$$

Example: $1,000 / 10,000 = $0.10 / mi × 1,000 mi = **$100**

Employee & Driver Benefits

Definition

Payroll taxes, benefits, recruiting, bonuses.

Formula

$$\text{Benefits CPM} = \frac{\text{Monthly Benefits Cost}}{\text{Monthly Miles}}$$

Example: $3,000 / 10,000 = $0.30 / mi × 1,000 mi = **$300**

Factoring Fees (Financing Cost)

Definition

% of invoices sold to get immediate cash.

Formula

$$\text{Factoring Fee} = \text{Invoice Value} \times \text{Factoring Rate}$$

Typical 2 – 4 %

Example: $3,000 × 0.03 = **$90**

Office Salaries & Management

Definition

Manager, safety, accountant, HR.

Formula

$$\text{Mgmt CPM} = \frac{\text{Monthly Salary Pool}}{\text{Fleet Miles per Month}}$$

Example: $8,000 / 40,000 = $0.20 / mi × 1,000 mi = **$200**

Taxes & Miscellaneous

Definition

Income taxes, IRP, HVUT, property taxes.

Formula

$$\text{Tax CPM} = \frac{\text{Annual Tax Estimate}}{\text{Annual Miles}}$$

Example: $6,000 / 120,000 = $0.05 / mi × 1,000 mi = **$50**

Summary Formula for Section 4

$$\begin{aligned}\text{Fixed/Overhead Cost per Trip} = &(\text{Insurance} + \text{Vehicle Payment} + \text{Licensing}) + \\ &(\text{Office Overhead} + \text{Software} + \text{Benefits}) + \\ &(\text{Factoring} + \text{Management} + \text{Taxes})\end{aligned}$$

Or in cost-per-mile form:

$$\text{Total Fixed CPM} = \text{Insurance CPM} + \text{Vehicle CPM} + \text{Compliance CPM} + \text{Tech CPM} + \text{Mgmt CPM} + \text{Tax CPM}$$

Master Freight Pricing Equation

$$\begin{aligned}\text{Freight Charge} = &\left[(\text{Miles} \times \text{Fuel CPM}) + \text{DEF} + \text{Tolls} + \text{Maintenance}\right] \\ &+ \left[\text{Accessorials} + \text{Equipment Fees} + \text{Reefer Cost} + \text{Storage}\right] \\ &+ \left[\text{Expedite/Team Premiums} + \text{Risk Factor} + \text{Weather Impact}\right] \\ &+ \left[\text{Market Factor} + \text{Deadhead Cost} + \text{Next Lane Adjustment}\right] \\ &+ \text{Profit Margin \%}\end{aligned}$$

Simplified:

$$\boxed{FreightCharge = (VariableCosts + OperationalCosts + StrategicAdjustments) \times (1 + Margin)}$$

Full Financial Freight Pricing Model (Sections 1 + 2 + 3 + 4)

$$\begin{aligned}\text{Total Freight Rate} = &[(\text{Variable Costs}) + (\text{Operational Costs}) + (\text{Strategic Adjustments}) + (\text{Fixed/Overhead Costs})] \\ &\times (1 + \text{Profit Margin})\end{aligned}$$

Expanded:

$$\begin{aligned}\text{Total Freight Rate} = &[(\text{Miles} \times \text{Fuel CPM}) + \text{DEF} + \text{Tolls} + \text{Maintenance}] + \\ &[\text{Accessorials} + \text{Equipment Fees} + \text{Reefer Cost} + \text{Storage} + \text{Insurance}] + \\ &[\text{Risk Factor} + \text{Market Conditions} + \text{Deadhead} + \text{Seasonal Adjustments}] + \\ &[\text{Vehicle Payments} + \text{Office Overhead} + \text{Software Costs} + \text{Factoring Fees}] \\ &\times (1 + \text{Margin})\end{aligned}$$

🧾 Output Metrics to Track

Metric	Formula	Insight
Cost Per Mile	Total Cost ÷ Miles	Baseline operating efficiency
Revenue Per Mile (RPM)	Freight Rate ÷ Miles	Market competitiveness
Profit Per Mile	RPM – CPM	Profitability per lane
Break-Even RPM	Total Cost ÷ Miles	Minimum acceptable rate

Calculation Pipeline (Deterministic Order)

All math is deterministic and idempotent. The same inputs yield the same outputs.

1. **Miles**
    - `miles_total = miles_loaded + miles_deadhead`
2. **Fuel & DEF**
    - Adjust **MPG** for **weight** and **altitude** (as defined earlier).
    - `fuel_gallons = miles_total / adjusted_mpg`
    - `fuel_cost = fuel_gallons * avg_fuel_price`
    - `def_gallons = fuel_gallons * 0.025` (default)

- `def_cost = def_gallons * def_price`

3. **Maintenance**
   - `maintenance_cost = miles_total * maintenance_cpm`
4. **Handling & Equipment**
   - `handling_cost` (floor_loaded, DC detention, driver assist, white glove, straps…)
   - `special_equipment_cost = Σ equipment fees`
5. **Reefer & Oversize**
   - `reefer_cost_per_hr = (reefer_gal_per_hr * avg_fuel_price) + reefer_maint_per_hr`
   - `reefer_base = reefer_hours * reefer_cost_per_hr`
   - `reefer_mode_multiplier` (1.35 if continuous else 1.0)
   - `reefer_cost = reefer_base * reefer_mode_multiplier`
   - `oversize_cost = (oversize_state_permits * oversize_permit_fee_per_state) + (escort_miles * escort_rate_per_mile)`
6. **Storage / Weekend**
   - `storage_cost = storage_days * daily_operating_cost`
   - `weekend_fee = weekend_hold ? daily_operating_cost * 0.25 : 0`
7. **Insurance per Trip (optional here or in Fixed CPM)**

    - `insurance_cost = insurance_cpm * miles_total`

8. **Variable Costs subtotal**

    - `variable_costs = fuel_cost + def_cost + toll_cost + maintenance_cost + handling_cost + special_equipment_cost + reefer_cost + oversize_cost + storage_cost + weekend_fee + tracking_fee + insurance_cost`

9. **Operational premiums**

    - `expedite_premium = expedite ? base_revenue * (expedite_multiplier - 1) : 0`

    - `team_premium = team_drivers ? base_revenue * (team_multiplier - 1) : 0`

    - `dc_cost = dc_pick_drop ? detention_hours * detention_rate_per_hr : 0`

    - `hotel_cost = hotel_nights * hotel_rate`

10. **Commodity / Endorsements / Military**

- `commodity_multiplier` from settings

- `endorsement_multiplier` = product of unique endorsement multipliers (or sum as premium)

- `military_fee = military_or_restricted ? military_flat_fee : 0`

11. **Strategic adjustments**

- `market_factor` via `market_index`

- `season_factor` percentage
- `risk_factor` percentage (weather/theft/route)
- `next_lane_adjustment` via `next_lane_factor`
- `lane_profitability_index` multiplier
- `cross_border_fee` if `cross_border`

12. **Backend/Dispatch**

- `backend_fee = backend_pct * (variable_costs + operational_costs_so_far)`

13. **Fixed Overhead (CPM mode)**

- `fixed_overhead_usd = fixed_overhead_cpm * miles_total`
- or compute each CPM component and sum.

14. **Subtotal & Margin**

- `subtotal_before_margin = variable_costs + operational_costs + strategic_adjustments + fixed_overhead_usd`
- `final_rate = subtotal_before_margin * (1 + profit_margin_pct)`

15. **KPIs**

- `rpm = final_rate / miles_total`
- `cpm = subtotal_before_margin / miles_total`
- `profit_per_mile = rpm - cpm`

Note: Where a step references “base_revenue”, use `variable_costs` as the base or introduce a pre-margin **baseline revenue** variable. In many shops, expedite/team are applied as **multipliers to subtotal_before_margin** instead (cleaner: fewer circular deps).