Truflation
US Methodology

Executive Summary

Sustainable economic growth can only come from a common understanding of the facts used as a basis for decision-making. To meet this need, Truflation built the first-of-its-kind infrastructure to provide unbiased financial data on a secure blockchain to ensure faster, more intelligent decision-making.

Truflation is based on market price data collected from more than 30 different data sources, comprising +10 million data points to deliver essential business intelligence around inflation and its underlying components. We provide daily unbiased data-driven inflation indexes and other economic metrics to financial products and applications through the Truflation Financial Index (Truflation) marketplace, dashboard, and APIs.

Content

Background to Truflation

Today, none of the traditional metrics make sense. This has been true for years, but a more recent combination of inflationary pressures driven by world events such as Covid-19, increased money supply, and crumbling global supply chains have pushed us to an inevitable tipping point; yet we persist with metrics of the past.

The frameworks for official financial indexes, including inflation figures in the United States and replicated elsewhere in the world, were launched during World War I over a century ago.

Since then, the inflation framework has only undergone several updates of substance. The last meaningful update to the inflation framework in the U.S. was in 1999, over 20 years ago. It came in a world where:

- Electric cars were only a distant twinkle in the eyes of futurists.
- iPhones and Facebook didn't exist.
- Netflix was a mail-based DVD rental company
- Google was brand new and wouldn't gain meaningful traction for another five years.
- E-commerce sales in the US represented 27 billion in sales... very much in its infancy compared to 2021 when revenue exceeded 870 billion[1].

But these aging metrics have been used by individuals, businesses, academics, and government-related organizations in the absence of a better alternative.

So, how could such an obsolete, outdated inflation measurement be fit for purpose in today's world? It simply isn't — and consequently makes it difficult to trust and use these numbers in a world that has undergone such change.

Fortunately, the arrival of new consumer and spending knowledge data sets, alongside new technological capabilities, can now be leveraged to meet the modern demands of businesses. Truflation has taken world-class data assets, put them in a secure environment and created the only verifiable daily inflation indexes in the world.

Truflation validates, harmonizes, and calculates outputs using open source algorithms. Our transparent methodologies are built and updated by our community.

The new metrics enable individuals, investors, businesses and institutions to make more informed decisions based on unbiased and transparent information. Trulfation delivers a financial information platform that seamlessly plugs directly into any workstream, in any industry, and geography.

It is a foundational growth engine that enables developers and entrepreneurs to build better products faster.

The Truflation assets are our products, tools and services:

Products	Truflation United States CPI Indexes
	Truflation United Kingdom CPI Indexes
	Truflation NFT Indexes

[1] https://www.statista.com/statistics/185283/total-and-e-commerce-us-retail-trade-sales-since-2000/

Tools	Truflation Dashboard
	Truflation Widget
	Truflation Forecaster
	Truflation Personal Inflation Calculator

Services	Truflation Marketplace

For the purpose of this document, we will be focused on the methodology for developing the Truflation Financial Indexes (Truflation). Should you wish to receive any additional information on the tools and services outlined above, see the end of this document for a brief summary or alternatively, contact us.

Truflation Indexes

Truflation provides a set of independent inflation indexes drawing on as many as 30 data sources and +10 million product prices at the country level. The indexes are released daily, making them the world's most up-to-date and comprehensive inflation measures.

Truflation released the first inflation index for the U.S in December 2021. A further 12 category-level inflation indexes[2] quickly followed. Since then, similar data sets have been released in the United Kingdom[3].

Inspiration for the new approach to inflation measurement came from a growing frustration with the relevance and timeliness of existing inflation numbers, particularly those released by the U.S. Bureau of Labor Statistics (BLS).

The methodologies of the BLS have not kept pace with the times we live in. The U.S. Consumer Price Index (CPI) is still only based on pricing data for 80,000 products. The CPI basket of goods is based on manual, often physical surveys with delayed collection cycles and makes limited use of digital data collection techniques. The risk of human error and survey bias is significant. Further bias is introduced to the numbers because government departments producing inflation metrics typically depend on departmental budget allocations to support their work.

Until now, independent measures of inflation have been challenging to develop because of regulatory influences and the heavy capital requirements to capture more relevant data sets. Additionally, those who did develop competing inflation metrics did so out of a commercial or political bias. The numbers tended to reflect those biases, and transparency was lacking.

Researchers, economists, and think tanks have been attempting to bring greater transparency to the process for decades. However, those goals have competed with the agendas of government departments producing the metrics when they are dependent on the departmental budgets that support their work.

Truflation has overcome these challenges to diversify and decentralize access to all layers of information collected and the calculations. It has no agenda other than providing the most complete, timely, and unbiased inflation data.

[2] https://truflation.com/blog/real-consumer-trends-propel-truflation-towards-global-scalability
[3] app.truflation.com

Truflation's outputs stand apart for the following reasons:

- Truflation makes the indexes available 30 times faster than current measurement tools and reports the indexes daily.
- Truflation licenses robust data from 30+ data providers and aggregators, resulting in having multiple data sources covering each category with different methodologies creating a more representative and balanced measurement tool.
- Leverages census-level data — enabling access to more than 10 million data points compared to the traditional index which only includes ~80,000.
- Data is transparent, on-chain, and verifiable. Truflation uses blockchain technology and open source algorithms to make the data more transparent and verifiable. Once on-chain, it also becomes immutable, tamper-proof, and compatible with multiple blockchains and web3 apps. Our independent financial metrics are unbiased, censorship-resistant, and verifiable. These metrics deliver the unfiltered truth, not what is politically expedient.

And this is just the beginning. The next level of decentralized finance (DeFi) is the convergence of centralized data and decentralized programmable money. Truflation is at the forefront of these changes, building a solid analytics platform for that transition.

Truflation Methodology

Truflation has a seven-step process for establishing a CPI index for modern needs. This approach requires the implementation of guardrails to ensure changes in the indexes are not a result of factors outside the core data collected. A consistent, balanced approach allows Truflation to aggregate multiple data sources into one number that represents the change in consumer prices.

The steps to achieve this are outlined below.

1. Establish household expenditures.
2. Enable data collection protocols and identify relevant sources for each expense type.
3. Apply quality control measures for validation and processing.
4. Apply a data revision process.
5. Establish the index calculation (and how it works).
6. Create the daily Inflation rate.
7. Distribution of the information.

Household expenditure establishment

Prior to setting up the Truflation US index, one needs to understand the structure of the population and establish how households are spending. Up-to-date information about the population structure is necessary to ensure accurate representation and weighting for each household spending category. In order to achieve this, it is important to understand:

- What the households spend their money on and the detailed allocation of the household basket of goods and services together with definitions.
- Determine the importance (weighting) of each of the expenditure categories to the household. Establish ways to cross-reference the data and then leverage this over time for forecasting capabilities.

Well-defined expenditure categories are a prerequisite to understanding expenditure baselines. The definitions should:

- be unambiguous to assure proper classification of household expenditures of goods and services

- consider the expenditure of goods and services of the given country
- enable validation/cross-referencing of the expenditure categories with alternative data sets

Table 1.0 highlights the twelve expenditure categories and their respective definitions that reflect the diversified set of products and services with which households engage.

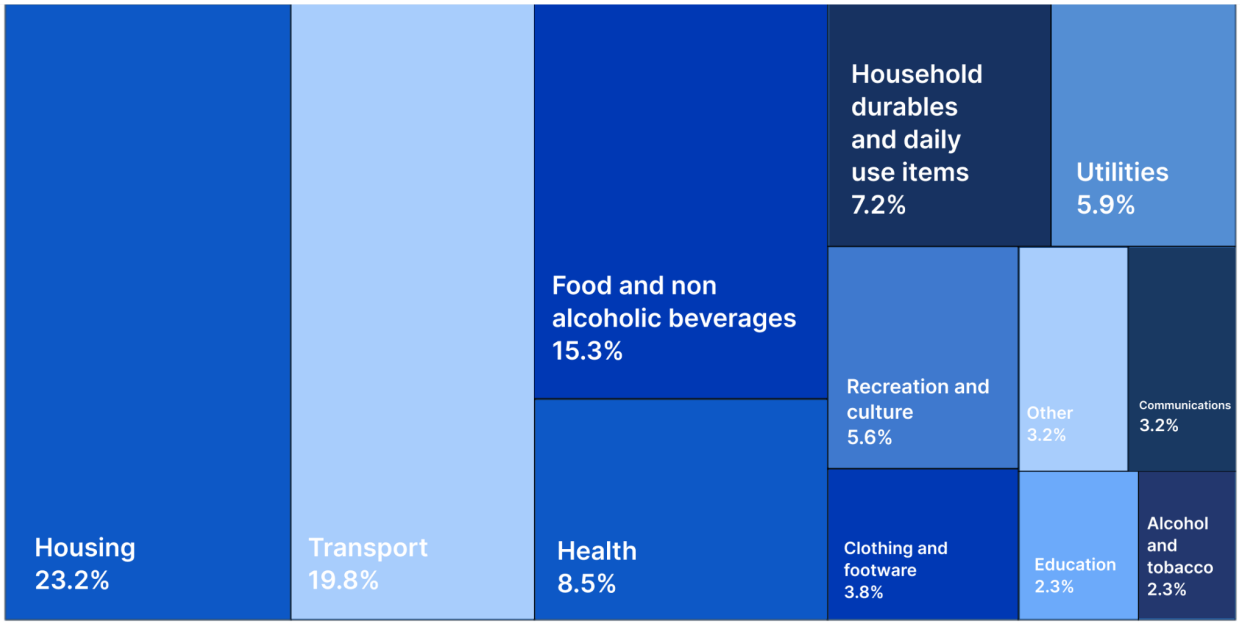
Expenditure Categories	Category Definition
Food & non-alcoholic beverages	1. Food at home (includes cereals & bakery products, meat, poultry, fish, eggs, dairy products, fruits & vegetables and other food at home) 2. Food away from home.
Alcohol & tobacco	1. Alcoholic beverages (beer, wine and spirits) 2. Tobacco products (all tobacco products and smoking supplies)
Clothing & footwear	1. Clothes 2. Footwear 3. Other apparel products and services.
Housing	1. Owned dwellings (includes mortgages, property taxes, maintenance repairs, insurance and other household expenses) 2. Rented dwellings 3. Other lodging
Utilities	1. Natural gas 2. Electricity 3. Fuel oil and other fuels 4. Water and other public services
Household durables and daily use items	1. Household operations (includes personal services and other household expenses) 2. Housekeeping supplies (includes laundry / cleaning supplies, other household products and postage and stationery) 3. Household furnishings and equipment (includes household textiles, furniture, floor coverings, major appliances, small appliances and miscellaneous household equipment)
Health	1. Health insurance 2. Medical services 3. Drugs 4. Medical supplies
Transport	1. Vehicle purchases (includes new cars and trucks, used cars and trucks and other vehicles) 2. Gasoline, other fuels and motor oil 3. Other vehicle expenses (includes finance charges, maintenance and repairs, vehicle leases, rentals licenses and other charges, and vehicle insurance) 4. Public and other transportation
Communications	1. Residential phone services, VOIP and phone cards 2. Cellular phone services
Recreation and culture	1. Fees and admissions 2. Audio and visual equipment and services 3. Pets, toys, hobbies and playground equipment 4. Other entertainment supplies and services
Education	1. Education 2. Reading
Other	1. Personal care products and services 2. Miscellaneous expenses

Table 1.0 – Truflation twelve categories and their definitions.

Each of the 12 categories represents a percentage of total household expenditure, and these category definitions are consistent for all markets covered by Truflation to ensure the indexes are scalable and comparable across markets. The relative importance of each of the categories however does vary by market.

Each category's relative importance/weighting is achieved by taking multiple sources and triangulating the impact. Data sources used for the Truflation index include the Census and Mini Census (where available), Bureau of Labor and Statistics and other household expenditure surveys used to create the consumer expenditure data. These data sources are then validated against assets from Truflation's data providers and other third-party sources (e.g. food spending with NielsenIQ, Walmart etc. and mortgage spending with financial institution data.) Combining these data sources and aligning the different methodologies allows Truflation to produce more reliable, unbiased data.

Once the weightings are established, the numbers are updated at the beginning of each year to reflect the changing consumer expenditure behaviors. In Graph 1.0 below, the relative importance of each of the 12 product categories for the US Truflation index can be seen.



Graph 1.0 – Truflation US category importance for 2022.

Data sources and collection protocols

Truflation works with a wide variety of data partners to ensure a diverse data pool and to establish the most accurate average prices in each of the categories and sub-categories. This approach minimizes the potential for error and avoids having any single point of failure. Truflation licenses data from commercial and public data sources, data aggregators, and research institutes.

The Truflation US Index licenses data from 30+ data providers and aggregators. Each of these data partnerships is tied to census-level data, meaning Truflation is accessing more than 10 million data points compared to the traditional index which includes only 80,000 data points.

The list of data providers is also dynamic. Truflation regularly adds data partners to the index. At present, the list of data providers includes (not exhaustive): NielsenIQ, Big Mac Index, Amazon, Walmart, Zillow, Trulia, Penn State University MRI (Marginal Rent Inflation) Index, Real Capital Analytics, Yahoo, Energy Information Administration, OPIS, AAA Gas prices, JD Powers, CarGurus, Numbeo, Statista, CoreLogic, Kantar, etc.

Each data partner updates data at different intervals, be it daily, weekly or monthly, which accordingly updates the Truflation index at the same interval. The net result is that Truflation makes its indexes available 30 times faster than current measurement tools, which only report monthly and with a 10-day delay. Truflation refreshes the indexes daily.

New data from each source is gathered daily at 10:30 PM Coordinated Universal Time (UTC). All the collected historical pricing data are loaded directly into a sandbox staging environment.

Data quality control measures

Truflation is committed to taking the necessary steps to ensure the delivery of the highest quality indexes. One of the most critical factors impacting data quality is the accuracy of the data and the representation of the data sources themselves. Truflation conducts an audit process before any set of information can become a certified data source. This auditing process includes (but is not limited to):

- Gathering detailed information on the methodology and data representation
- Determining the quality control procedures and validation systems.
- Administrative and legal review

The goal is to identify and eliminate potentially fraudulent data providers before adding the data sources into the Truflation Oracle. Once the data is verified, it is added.

Before the data is verified, it enters the Truflation sandbox, where it is validated by assessing the following steps (some steps are only applicable to certain datasets):

- **Data presence:** Review the most recent data to ensure at least 13 consecutive months of data is available from that source to obtain year-over-year comparisons. If this is not present, then a red flag is raised.
- **Historical data comparison:** Compare the most recently received data with previous data in the Truflation database from the same source to assess consistency. If there are discrepancies, then a red flag is raised.
- **Current data comparison:** Analyze the most recent data input and ensure the data is not the same as the previously logged data or establish that there is no missing data. If the latest data is no different than the latest data in the Truflation database or there is no data, then a red flag is raised.

Once the new data has been screened and validated, it moves to more quality control — a daily automated data check where a red flag is raised if variation in the most recent data is greater than 10%, either positively or negatively, from the previous data set from the same source.

If no red flag is raised, then the final data is cleared and moved out of the sandbox into the Truflation database where it is stored and ready to progress to the calculation stage.

If however, a red flag is raised, there is a need to revert back to the data source provider to dissect and verify the data set. The data query is typically resolved, either by having an accepted rationale to the jump in the data that breaks the 10% data bands or alternatively, with the data being updated/replaced. Before a new explanation is accepted, it is reviewed by two individuals who both need to approve and clear the data before it is green-lit to go through the screening, validation and data quality controls all over again.

Throughout the duration of that data source being red flagged, it is not allowed to leave the sandbox and is excluded from the calculation phase.

If the process of dissecting and verifying the red flagged data takes more than 1 day, then the most recent data in the Truflation database from that data source is repeated and injected as interim data. This process is to be continued until we have the new data green flagged and cleared, at which point the new/actual data replaces the interim data and proceeds to the calculation stage.

Once the data has completed the quality control process it is ready to progress to the calculation phase. The data in the Truflation database is locked for 24 hours and during this time, no data can be changed.

Data revision management

Apart from updating data, other factors need to be taken into account that influence the trending of the data. There are 3 main reasons for any changes in the data that Truflation represents:

1. New / old data sets are added / removed to / from the Truflation indexes on a monthly basis during our index updates.
2. Existing data providers upgrade / improve their data for a number of reasons
3. Any updates in Truflation's calculation model due to raw data additions, updates on the household expenditure survey etc.

All these factors can change the trending of the Truflation indexes. The data is only updated during our monthly update on the last day of the month. If there is an update to be included in the current month, a parallel run is conducted to understand the impact. Comparing the results from a parallel run consists of the following actions:

- Explain the differences in the data if there are differences found for any of the key metrics.
- Ensure each component is thoroughly checked using the right resources and methods.
- Log the impact of the change for each data set into Truflation's quality control logbook that is made available.

Data calculation

Once the data proceeds to the database, it is locked for 24 hours. The delay in running the algorithm accommodates time for any red flag resolution if needed. If there are no red flags and all the data clears the automated process, Truflation still reports the data with a 24-hour delay. The calculation algorithm is deployed at the end of the 24-hour window, and the new Truflation index for that day is created and ready for reporting. This means that on July 23, 2022, we will release the Truflation index from July 22, 2022, and so on.

Truflation obtains price data for various subcategories of goods and services, and our datasets are then benchmarked to January 2010, set as our base index of 100. A difference between today and 2010 is then measured.

Truflation keeps the fundamental premise of the year-on-year CPI as the measurement of the percentage price change of goods and services between two consecutive years (year-over-year CPI).

The Truflation index calculates its YoY for each day of the year instead of each month like the official CPI.

$$\text{YoY CPI} = \text{CPI1}/\text{CPI0} * 100 - 100$$

where:
CPI1 - the cost of the basket of goods on a day X the year n+1
CPI0 - the cost of the basket of goods on a day X at the year n.

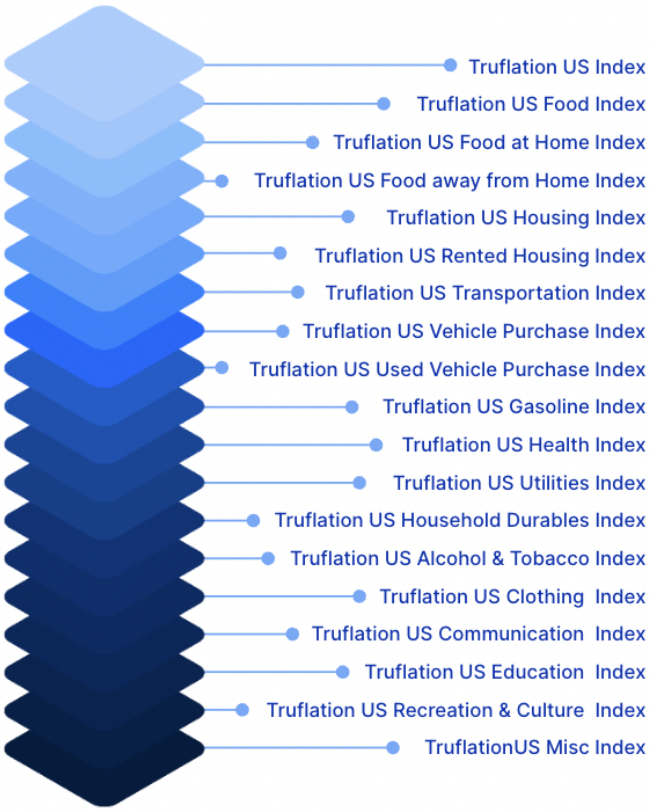
All indexes are then combined into an inflation metric **through a weighted average**: multiplying the index by its relative importance (weight) of the household expenditure category.

Daily Truflation Indexes

To report the most accurate data and ensure the data reported is immutable, any historical data that is reported will remain unchanged. However, in our oracle, we will ensure the historical data is updated dynamically. This means that during the product updates the historical data will reflect the most current and comprehensive information about inflation. That causes historical changes to our data and is reflected in some fluctuations of the yearly charts and the lowest and highest YTD (Year to date).

The Truflation US Index and the category-level data is currently available on the Truflation Portal. However, there are additional indexes available on-chain through the Truflation marketplace.

There are a total of 19 Truflation price indexes currently available for the U.S. They are:



Data reporting

All Truflation data is available through one of the following channels:

- Decentralized Truflation Marketplace
- A dashboard
- A widget
- Centralized API
- Or any other friendly delivery format

The Truflation Oracle reports as standard, three different types of numbers depending on how the data is accessed:

1. Price index of today
2. Price index one year ago today
3. Year-over-year percentage change today vs. a year ago today

The price index data allows Truflation oracle users to calculate a percentage change at selected custom intervals such as half-year, month-over-month and day-over.

The dashboard reports year-on-year percentage change for each day of a year, going back one year. It reports this for inflation and its 12 main categories.

Other Indexes

Truflation is working on introducing macroeconomic indexes that help further explain the drivers of the Truflation category indexes, be it commodity prices, precious metal prices, or other economic data.

Conclusion

Truflation's U.S. CPI index offers an unmatchable set of real-time data for macroeconomic analysis. It provides users with previously unavailable data that can be deployed to enable better-informed decisions. Truflation is built on the following foundations:

1. Data Sources: 30+
2. Data points: 10 million +
3. Frequency of Update: Daily
4. Last Household Expenditure Update: 2021

The groundbreaking new indexes can be used for everything from smarter, faster market hedges to helping offset costs in new product development.

For further detail, please contact us:

- Contact us: https://truflation.com/contact-us
- Twitter https://twitter.com/truflation
- Telegram: https://t.me/truflation
- Linkedin: https://www.linkedin.com/company/truflation

Brief outline of Truflation other tools and services

Truflation Dashboard

The Truflation dashboard is a data visualization tool connected to the Truflation index API that calculates the most current inflation rate and price indexes for the 12 main product and service categories included in the inflation calculation, like food or housing. It provides users with a glimpse past the reported data and to see daily, weekly, monthly and yearly changes. All dashboard charts are updated according to the UTC timezone.

Truflation Widget

The widget is available to incorporate into websites, data dashboards, and web3 apps. It comes with a custom design and features implemented on a case-by-case basis.

Truflation Personal Inflation Calculator

The Truflation Personal Inflation Calculator estimates an inflation rate based on personal household spending patterns and compares this with the general purpose Truflation index number. The calculator uses the latest data available from Truflation daily inflation indexes.

Truflation Oracle

Truflation Oracle is a node on the Chainlink oracle network that feeds the Truflation index data into smart contracts across four blockchains: Ethereum, Avalanche, BNBChain, and Fantom. Translating Truflation data to on-chain format helps blockchain developers to use the data to create inflation-proof solutions and products.

Truflation Marketplace

The Truflation Marketplace is a global source of financial and economic data for web2 and web3. It connects the community of developers and data scientists with organizations that seek unique business insights and offers both an access to robust, quality controlled, and validated datasets and data sources.