# Brewing

COFFEE DATA VISUALIZATION

**SUNDIAL**

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**Tsoi Chun Wong**
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# Brewing Ideas

*WHEN WE COULDN'T ANSWER SIMPLE QUESTIONS ABOUT OUR FAVORITE BREW, WE BUILT A VISUAL NARRATIVE THAT FINALLY COULD.*

Our journey started in a café on a rainy afternoon. The three of us – Ryan, Chi Yuk, and Chun Wong – were arguing about which coffee origins were best. Pretty soon we hit questions none of us could really answer. Why does Ethiopian coffee have that distinct flavor compared to Colombian? How exactly do beans travel from farms in remote mountains to our cups? What causes those wild price swings? Our curiosity was sparked, and this data viz project was born.

Digging into research, we found a fragmented mess of information. Coffee is one of the world's most traded commodities. Billions drink it daily. Yet the connections between growing, quality, global movement, and economics remain mostly invisible to the people actually drinking it. We saw plenty of visualizations focusing on isolated pieces – production stats here, quality metrics there, some trade flow diagrams – but nobody had connected these elements into a story showing coffee's complete journey.

We found four datasets that, together, could tell this story. The CORGIS Coffee Dataset gave us detailed quality metrics for beans from different regions. Resource Trade Earth had comprehensive import/export data tracking how coffee moves globally. The USDA's statistics documented production changes from 2015-2024. And MacroTrends provided historical price data showing market ups and downs. Combined, these datasets let us visualize the entire coffee ecosystem.

We weren't interested in making just another coffee visualization. We wanted an interactive platform that would speak to different people: coffee lovers curious about what makes their favorite origins special; industry pros tracking market trends; students learning about global agricultural trade; researchers studying economic and environmental factors affecting coffee farms. We imagined someone tracing the journey of beans from their favorite region or finally understanding why their morning cup suddenly got more expensive.

Our notebooks filled with sketches, our minds buzzed with ideas (and probably too much caffeine). We committed to creating something both analytically solid and visually stunning – a platform turning complex data into an accessible, engaging exploration of the world's favorite bean.

# Sketching Concepts

*WE SKETCHED. WE DEBATED. WE DIVIDED RESPONSIBILITIES. BUT WE ALL SHARED ONE BELIEF: USERS SHOULD EXPLORE COFFEE'S STORY THROUGH THEIR OWN CURIOSITY, NOT OUR PREDETERMINED NARRATIVE.*

Our project began with intense brainstorming in a corner of Ryan's dorm. We transformed it into our coffee visualisation headquarters – laptops open, sketchbooks scattered, and a French press always brewing. Ideas flowed as freely as the coffee we consumed. We generated dozens of visualisation concepts, from simple bar charts to ambitious interactive globes. We would pass notebooks back and forth, evolving ideas together, sometimes leaving coffee stains on pages that seemed perfectly appropriate for our subject.
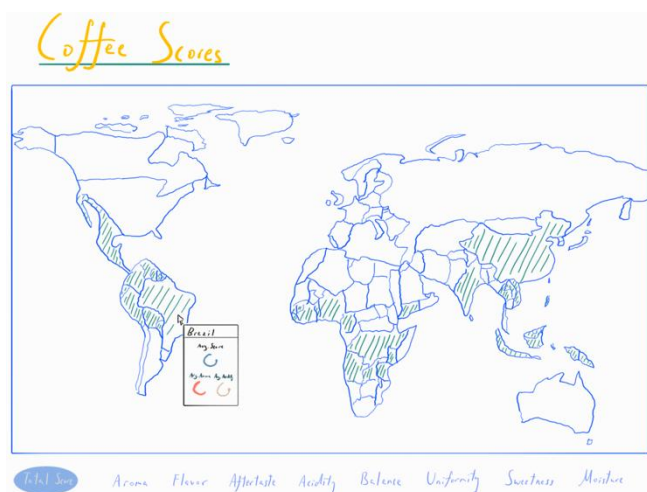


We quickly realized one visualization wouldn't cut it. Coffee's story is too complex, too interconnected. After days of back-and-forth and countless revised sketches, we landed on four main pieces: a Coffee Bean Atlas showing where beans grow and their qualities; Global Coffee Flows tracking how beans move around the world; a Production Landscape showing changes over time; and a Price Observatory to make sense of market ups and downs.

We wanted to build something that rewarded curiosity. Not a presentation with neat conclusions, but a tool where people could follow their own questions. What are the major countries that import and export coffee beans?

How to the beans flow around the world? What are the factors that impact coffee price? These were the kinds of questions we wanted users to explore.

Picking the right tech sparked some heated debates. The interface design nearly caused a fight – Ryan pushed for an all-in-one dashboard while Chi Yuk wanted separate, focused sections. We ended up somewhere in the middle: distinct visualization spaces but with navigation that keeps context as you move between sections.
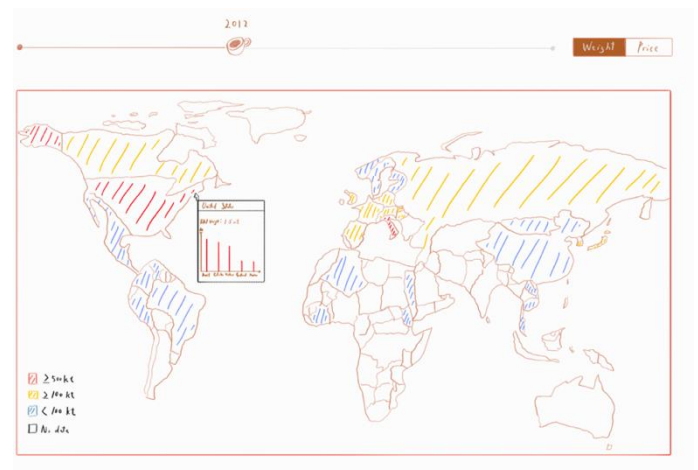


As the concept is confirmed, We split the work based on what each of us does best. Ryan had the CS background, so he took on the Coffee Production & Quality piece. Chun Wong had done network visualizations before, so Global Trade Flows made sense for him. Chi Yuk knows time-series analysis, so he handled Production Trends and Prices. But we still met regularly to review progress and tackle problems together. The hardest challenges needed all our brains anyway.

# Production & Quality

*WHEN MY TEAMMATES REJECTED MY SIMPLISTIC APPROACH TO MAPPING COFFEE QUALITY, I DISCOVERED THAT VISUALIZING THE TRUE CHARACTER OF BEANS MEANT EMBRACING THEIR CONTRADICTIONS – WHERE "BETTER" MATTERS LESS THAN "DIFFERENT."*

My visualization journey began with something seemingly simple: plotting coffee-producing regions on a world map. My first prototype simply colors the countries by their overall quality score. I was excited to present it to the team, but their feedback quickly revealed the limitations of this approach. Chi Yuk pointed out that reducing coffee quality to a single total score missed the essence of what makes coffee interesting – its multidimensional flavor profile. These insights forced me to reconsider my fundamental approach.

Coffee quality isn't one-dimensional – an Ethiopian Yirgacheffe isn't objectively "better" than a Sumatran Mandheling; they offer profoundly different sensory experiences. This realization led me to redesign the visualization around this complexity.



Coffee Production & Quality

The redesigned visualization now embraces this nuance. Users can toggle between different quality categories – total score, moisture, aroma, aftertaste, acidity, or sweetness – via interactive buttons. Selecting a country triggers two coordinated views: an animated arc chart panel that highlights the chosen country's performance like a dial gauge, instead of a hover panel for clearity, and a dynamic bar chart that ranks all countries in descending order. The bar chart uses color gradients to intuitively convey performance, while smooth transitions keep the experience cohesive.

The technical execution required careful problem-solving. Standardizing country names across datasets was unexpectedly tedious – resolving discrepancies like "United States" versus "United States of America" demanded meticulous data cleaning. I also needed to balance depth with usability. Early tests showed that users felt bombarded when all metrics appeared at once, so I adopted progressive disclosure: the default view emphasizes the total score, while secondary layers let users explore finer details.
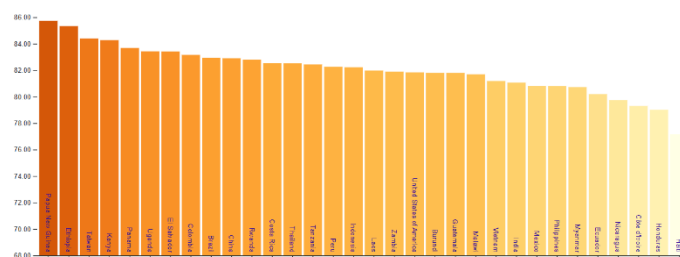


For the visuals, I prioritized both aesthetics and accessibility. Built with D3.js, the map and charts feature fluid animations to maintain context during interactions. The color palette walks a tightrope – evoking coffee's natural warmth while ensuring clarity for colorblind users.

**Brazil**

The Total Score Score

83.0

Whether filtering by flavor attributes or zooming into specific growing regions, users can uncover how terroir shapes each cup. The arc chart personalizes the experience, making abstract scores feel tangible, while the sorted bar chart reveals global patterns at a glance. What began as a simple mapping exercise has become a tool that celebrates coffee's diversity, bridging the gap between data and sensory experience.

Written: **LIEU KAIXUAN RYAN**

# Global Trade Flows

*WHEN MY INITIAL TRADE VISUALIZATION COLLAPSED INTO AN UNUSABLE TANGLE OF LINES, I DISCOVERED THAT SHOWING COFFEE'S GLOBAL JOURNEY REQUIRED BLENDING ANIMATED 3D ARCS WITH DETAILED SANKEY DIAGRAMS THAT REVEAL BOTH PATTERNS AND STORIES.*

Coffee travels an incredible path from remote mountain farms to urban cafés. This complex web of global trade was mostly invisible to me until I started this visualization project. When our team split up tasks, I jumped at the trade flow component. I was fascinated by the challenge of visualizing these intricate international relationships. The Resource Trade Earth dataset blew my mind – millions of tons of coffee product crossing borders every year going from everywhere to everywhere. The coffee market is a massive trading web between each and every country.

My first design was simple: loading up a map of the entire world in vector format, and adding a straight line for each pair of trading countries per year. The map immediately devolved into an unrecognizable mess, with the entirety of Europe and Africa being buried by hundreds of vectors. It is clear that there is a lot of organization and simplification to be done. I soon changed the map to display sums of all coffee product types in only 1 year of trades at a time, but most countries were still trading with over 20 other countries every year. I had no choice but to limit each country to only display their top 2 importing / exporting countries. With the clutter finally clearing up a little, this was a promising first step.

To provide more information of the trades, a simple method would be to increase the line thickness to show trade volume. I quickly built a prototype and proudly showed it to the team. It was a big improvement over the first prototype, but the team agreed that the map remained hard to understand. I then added arrowheads to show direction, added blue interpolation and made the arrows curved and half-transparent. This allowed countries previously buried to now be able to show on screen, at the same time allowing arrows to be distinguishable from each other.

The map looks way better now with comprehensible arrows. We can easily observe that, say, Brazil is a major coffee exporter. While the limit of 2 arrows per country helped with decluttering the screen, the data overall is too oversimplified. Thus, I decided to add hover triggers, making it possible to only show trades with individual countries. We will also dynamically adjust the legend and arrow interpolation based on the largest value in the current display. Along with buttons & a dropdown menu enabling selection of import / export and trade year, we now have the space to increase the number of displayed trades to show much more data in detail.

To better show detailed information for each trade, I also added tooltips with information on each trade and country when hovering on countries and trade arrows. This helped allow in-depth analysis of each trade between every country, making our map support visualization both on a macro and micro level.



As the visualization matured, fascinating insights emerged. Brazil, Vietnam, and Colombia dominate exports, as expected, but I was surprised by how their beans reach consumers. The visualization revealed the crucial role of re-exporting hubs like Germany and Belgium, which import raw beans, process them, and re-export to other countries. It also captured coffee's dramatic expansion into China and Russia over the past two decades as coffee culture spread to new markets.

Our final product transforms large amounts of abstract trade statistics into a dynamic, explorable journey, connecting coffee drinkers to the global networks behind their cup – making visible the economic relationships we never see during our morning coffee ritual.

Written: **TSOI CHUN WONG**

# Production & Price

*MY JOURNEY FROM BASIC LINE CHARTS TO CONTEXTUAL ECONOMIC NARRATIVES TAUGHT ME THAT COFFEE'S PRICE STORY ISN'T JUST IN THE NUMBERS BUT IN THE FROST-DAMAGED CROPS, PANDEMIC-DISRUPTED SHIPPING LANES, AND CHANGING CLIMATE PATTERNS HIDDEN BEHIND THEM.*

I got hooked on coffee economics during a commodity markets course. Those wild price swings and their impact on farming communities fascinated me. When our team started this project, I grabbed the production and price components immediately. I needed to show how global coffee production has evolved and how market prices respond to changing supply, demand, and external shocks.

The USDA dataset looked simple. It wasn't. My first sketches used basic line charts showing production volumes by country. Ryan quickly pointed out the problem – users need to see both individual country trends and their place in the global picture. My simple charts couldn't do both.



After several failed attempts, I built a stacked area chart showing total global production and each country's contribution simultaneously. I used color intensity to highlight major producers, creating instant visual understanding of the industry's concentration. I added interactive elements letting users isolate specific countries or time periods.

For price analysis, I wanted something better than standard financial charts. Coffee prices tell a complex story shaped by production volumes, speculation,



consumption trends, and macroeconomics. I integrated price data and annotated market events to better explain not just the price spark but the reasons behind them.
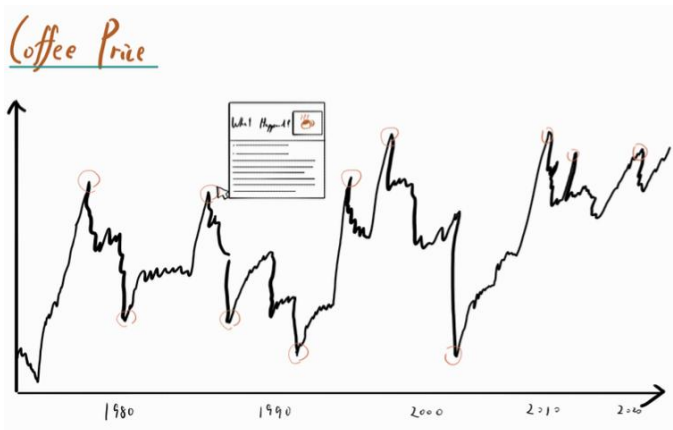


The final implementation features a multi-axis visualization aligning price trends with production years. Interactive annotations highlight key events that shocked the market – from the devastating Brazilian frosts to COVID supply chain meltdowns. These contextual elements transform abstract price lines into an understandable story about real-world events.



The completed visualizations reveal hidden patterns. Production has become increasingly concentrated, with Brazil and Vietnam now accounting for over 50% of global output. An unexpected insight emerged when connecting production data with price trends – coffee price volatility correlates directly with production volume fluctuations, which are increasingly driven by climate events.

What began as cold data points became a powerful narrative. Our coffee cups now tell a story that spans continents, economies, and futures. The visualization makes the abstract immediate, the global personal, and the complex undeniable.

Written: **KAO CHI YUK**
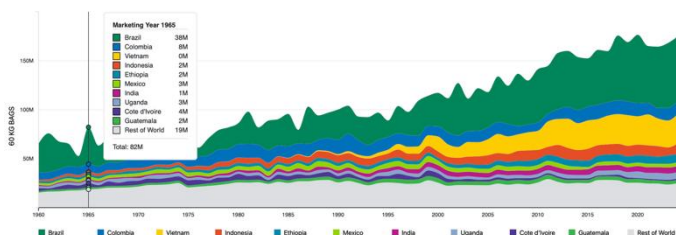
# Technical Challenges

*BENEATH OUR SMOOTH VISUALIZATIONS LURKED A TECHNICAL OBSTACLE COURSE – INCONSISTENT COUNTRY NAMES, MISALIGNED TIME PERIODS, AND ANIMATION BOTTLENECKS – THAT TRANSFORMED OUR CODING SESSIONS INTO CAFFEINE-FUELED PROBLEM-SOLVING MARATHONS WITH OCCASIONAL VICTORY HIGH-FIVES.*

What users see is just the surface. Underneath lies a technical architecture that demanded as much creativity as the visual design. Our journey involved countless late nights, debugging sessions fueled by the very subject of our visualization, and triumphant celebrations when particularly stubborn features finally worked.

Data processing was our first nightmare. Four datasets arrived in inconsistent formats with varying levels of messiness. We built a Python pipeline to transform this raw material into visualization-ready resources. Normalizing country names was maddening – "Côte d'Ivoire" in one dataset, "Ivory Coast" in another. We created a master reference table mapping all variants to canonical names.

Geographic integration nearly broke us. The CORGIS dataset listed coffee origins by region names (like "South Korea" and "North Korea") without coordinates, while our maps needed exact latitude and longitude for the trade arrows. After searching online for modules providing coordinates to all locations in our database, we were unable to find a perfect method, and resorted to painstakingly building a coordinate dictionary mapping to countries.

These technical challenges pushed us beyond our comfort zones, requiring us to learn new approaches overnight and occasionally reimagine features entirely. Yet these limitations sparked creative solutions that ultimately enhanced the final visualization – proving that technical constraints can drive innovation when approached with enough coffee, persistence, and occasional swearing.

These technical challenges pushed us beyond our comfort zones, requiring us to learn new approaches and occasionally reimagine features to work within technical constraints. Yet these limitations sparked creative solutions that ultimately enhanced the final visualization – proving that technical constraints can drive innovation when approached with persistence and creativity.

# Team Contributions

*WHAT BEGAN AS CURIOUS QUESTIONS OVER COFFEE CUPS BECAME SPECIALIZED COMPONENTS THAT, WHEN CONNECTED, REVEAL THE INVISIBLE GLOBAL SYSTEMS BEHIND YOUR MORNING BREW.*

As we put the finishing touches on our visualization platform, the lab smelled like a café. Looking back – from initial curiosity to completed project – we felt genuine pride in what we'd created. Those simple questions about our daily coffee had evolved into a comprehensive platform connecting the dots between coffee's production, quality characteristics, global movement, and economic value.

We successfully integrated four distinct datasets into a cohesive, interactive experience revealing the interconnected nature of the global coffee ecosystem. Through iterative design, technical problem-solving, and constant user feedback, we transformed complex data into accessible insights that invite exploration. The platform doesn't present conclusions – it empowers users to discover their own insights by exploring connections between coffee's geography, flavors, trade patterns, and market dynamics.

The completed visualization achieves our original goals while expanding in unexpected ways. It reveals geographical patterns in coffee quality. It illuminates the complex global trade networks transporting beans from farm to consumer, highlighting surprising intermediaries. It documents how production has evolved over the past decade, revealing increasing concentration among major producers and vulnerability to climate events. And it contextualizes price movements, connecting abstract market forces to real-world factors influencing what we pay for our daily cup.

This project taught us lessons beyond coffee visualization. We discovered that data integration is often more challenging than the visualization itself – merging datasets with different granularities, timeframes, and geographic references required sophisticated approaches and countless late nights. We learned the importance of progressive disclosure – providing immediate value while letting users discover depth gradually. Most

importantly, we realized that effective domain-specific visualization requires cross-disciplinary knowledge – our visualization improved dramatically as we deepened our understanding of coffee production, processing, and markets.

| Task | Person-In-Charge |
|---|---|
| Code – Coffee Production & Quality | **LIEU KAIXUAN RYAN** |
| Code – Global Trade Flows | **TSOI CHUN WONG** |
| Code – Production Trends & Price Analysis | **KAO CHI YUK** |
| Code – Site Layout | **LIEU KAIXUAN RYAN** |
| Process Book – Design and Main Content | **KAO CHI YUK** |
| Screencast | **TSOI CHUN WONG** |

For the future, we see exciting possibilities: integrating real-time price data, expanding quality metrics with detailed flavor profiles, developing predictive models based on climate data, and adding sustainability metrics showing environmental impacts.

We hope this visualization platform serves as both an educational resource and exploration tool, helping users understand the complex journey from bean to cup while appreciating the interconnected nature of our global coffee system. Beyond its specific content, our project demonstrates how thoughtful data visualization can transform complex, multi-dimensional data into accessible insights revealing the hidden connections shaping our world – one cup at a time.

## Appreciation

We extend our sincere gratitude to the organizations that made their data available: the CORGIS Project, Resource Trade Earth, the USDA, and MacroTrends. Their commitment to open data access made this project possible and exemplifies how data sharing enables new insights and understanding. And finally, we thank the countless farmers, traders, roasters, and baristas whose work forms the real-world foundation of the story our visualization tells.