Core Methodology and Chronos-Bolt Advantage

Our consulting methodology centers on replacing static benchmarks with **dynamic, data-driven forecasts** using the **Chronos-Bolt** model. Chronos-Bolt is a cutting-edge **Time-Series Foundation Model (TSFM)** developed by AWS, and it serves as the analytical engine for our benchmarking solutions. We combine this powerful model with domain expertise to deliver practical performance targets. The core elements of our methodology include:

1. Chronos-Bolt Overview: Chronos-Bolt is a large-scale pretrained model built specifically for time-series forecasting. It's based on a Transformer architecture (similar to those used in language AI) and has been trained on **nearly 100 billion time-series observations** spanning diverse domains . This training imbues the model with a broad "knowledge" of temporal patterns. Unlike traditional models that must be trained on each new dataset, Chronos-Bolt can perform **zero-shot forecasting** – producing accurate predictions on unseen data without additional training . It essentially **"learns the language of time series,"** tokenizing historical data and applying deep learned patterns to forecast the future . The result is a **ready-to-use forecasting engine** that drastically lowers the complexity and entry barrier for advanced analytics .

2. How It Works: In practice, our team feeds a client's historical performance data (e.g. monthly sales per region, weekly injury counts, hourly production output, etc.) into Chronos-Bolt's prediction pipeline. The model splits the history into encoded patches and directly generates multi-step forecasts for the desired horizon . Chronos-Bolt automatically captures trends, seasonality, and anomalies in the data, often incorporating relevant covariates (like calendar effects or external indicators) if available. There is **no need to manually test for stationarity, seasonal indices, or craft custom features** – tasks that made ARIMA and other methods labor-intensive. As one guide observes, *"classical methods like ARIMA need stationarity checks and manual feature tuning, whereas the foundation model skips these hurdles by automatically learning seasonality, trend, and pattern shifts"* . In short, Chronos-Bolt **automates the heavy lifting** of time-series analysis, allowing our consultants to focus on interpreting results and tailoring benchmarks to business use.

3. Chronos-Bolt vs. Traditional Benchmarks: The advantages of Chronos-Bolt's approach become clear in comparison to two common alternatives – naive benchmarks and ARIMA (a proxy for traditional statistical models). The table below highlights key differences:

Benchmarking Approach	Setup Time & Complexity	Forecast Accuracy	Interpretability	Scalability & Cost
Naive Benchmark (static avg or last-year)	**Minimal:** Calculation is trivial (e.g. last year's value or average to date). No modeling required.	**Low:** Ignores trends/seasonality; often yields large errors or bias. Serves only as a rudimentary baseline.	**High:** Easy to understand ("last year we did X, so target X"). No complex logic – but also no insight into future changes.	**Very High:** Essentially zero cost or compute needed. Scales trivially, but the **cost is in efficacy**, as poor benchmarks can hurt performance.
ARIMA (classical statistical model)	**Moderate to High:** Requires data preprocessing (stationarity/differencing) and parameter tuning per time series. Skilled analysts or iterative auto-	**Moderate:** Can capture linear trends and seasonality well for short horizons. However, accuracy drops on complex, non-linear patterns	**Medium:** ARIMA's parameters (lags, seasonal terms) have some intuitive meaning, and results can be explained in terms	**Limited Scalability:** Fine for a few series, but fitting separate models for hundreds of metrics is

	ARIMA processes needed for each metric.	or during regime changes . Often lags more advanced models on diverse datasets.	of trend/season components. It's more interpretable than a neural network, but still limited in explaining sudden shifts.	time-consuming. Compute cost is low (runs on CPU), but **labor cost is high** for maintenance. No inherent ability to handle many series jointly.
Chronos-Bolt (Foundation Model)	**Low: No model training needed** for new data; just input the historical series and get forecasts. Setup involves data formatting and invoking the pre-trained model, which is straightforward.	**High:** Captures complex patterns and **consistently outperforms common statistical models and even specialized ML models** on new datasets . Provides both point forecasts and uncertainty ranges for robust planning.	**Low:** As a sophisticated deep learning model, Chronos-Bolt is largely a "black box." While it automatically accounts for seasonality/trends, it doesn't provide human-readable equations. (Classical models like MSTL can rival it in stable seasonal cases due to their explicit, interpretable structure .)	**High: Highly scalable and fast** – a single model can forecast thousands of series in parallel. Chronos-Bolt is **up to 250× faster** than prior Chronos models , and it runs on commodity hardware (even CPU) in smaller variants . This reduces infrastructure cost and allows cost-efficient analysis of many metrics at once.

Table: Comparison of Benchmarking Approaches – naive vs. ARIMA vs. Chronos-Bolt. The Chronos-Bolt approach clearly stands out for its **accuracy and scalability**, while drastically cutting the setup time compared to building many individual ARIMA models. Although it sacrifices some interpretability (a trade-off typical of advanced AI models), our consulting practice mitigates this by translating the model outputs into business context for clients.

4. Practical Use in Benchmarking: Chronos-Bolt's forecasts become the basis for **custom performance benchmarks**. For example, instead of setting a blanket +5% sales increase for all regions, we forecast each region's sales given its trends and external factors, then set **quota benchmarks close to the model's projection** (with perhaps an aspirational stretch). This means each rep's target is grounded in an analytic prediction, making it **"motivational, accurate, and defensible"** rather than arbitrary . We follow a similar process for other metrics: forecast incidents for each plant to set safety targets, forecast output for each production line to set bonus thresholds, etc. Our consultants review the model outputs with client stakeholders (incorporating their domain knowledge) to finalize benchmarks that balance realism with strategic goals. The result is a methodology where **advanced analytics inform human decision-making** – we use Chronos-Bolt to crunch the numbers, then collaborate with management to adjust for any qualitative considerations (e.g. upcoming policy changes, one-off events not in data). This human-in-the-loop approach ensures the benchmarks are not only data-driven but also business-aligned.

5. Chronos-Bolt in Context of ARIMA Benchmarks: It is worth noting how Chronos-Bolt even improves on organizations' in-house forecasting efforts. Traditional ARIMA or ETS models remain widespread as baseline tools, but they have clear shortcomings. Studies have shown that **foundation models like Chronos can significantly outperform ARIMA and other classical methods** on a variety of datasets . In one head-to-head comparison, Chronos (the precursor to Chronos-Bolt) delivered *dramatically lower error rates than AutoARIMA* on an electricity usage forecast, and provided predictive uncertainty ranges that ARIMA lacked . ARIMA is still *"reliable and interpretable for simpler problems,"* but it struggles with **nonlinear dynamics, regime shifts, and lacks native uncertainty estimates** . By contrast, Chronos (and by extension Chronos-Bolt) offers **"superior accuracy, better generalization to volatile patterns, and predictive intervals for risk-aware forecasting"** . This technical edge translates into our clients getting **more precise and robust benchmarks** than they would with legacy statistical approaches. Moreover, because Chronos-Bolt is pre-built, our clients **avoid the heavy implementation effort** that ARIMA would require across dozens of metrics – no need for separate models or constant re-tuning whenever new data arrives or conditions change.

In sum, our core methodology marries the **latest AI forecasting technology (Chronos-Bolt)** with expert consulting to overhaul how benchmarks are set. By doing so, we ensure our clients' performance targets are **data-driven, fair, and future-focused** – turning what was once a guesswork exercise into a strategic advantage.