

SAINT LUCIA POLICY ANALYSIS

RESEARCH PAPER

When Arrivals Recover but Paid Nights Do Not

Measuring Tourism Recovery under Incomplete Accommodation
Coverage in Saint Lucia

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Evidence, methods, executed results and reproducibility appendices

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Abstract

Visitor arrivals, paid accommodation nights, domestic production and income accruing to residents measure different aspects of tourism recovery. This paper reconciles Saint Lucia's published record and develops a decision protocol for cases in which those measures diverge. It assembles 132 monthly arrival observations for 2015–2025, a common-vintage annual visitor series for 2011–2025, and separately classified incomplete 2026 evidence. In 2025, stay-over arrivals were 0.7% above 2019, while published paid nights were approximately 13.6% lower. Real accommodation-and-food-services gross value added was 9.7% higher, providing contrary evidence to a simple equation of fewer nights with lower domestic production, although industry GVA is not tourism direct value added. An exact symmetric decomposition allocates the approximately 380,000-night decline to an arrival contribution of +18,000 and a published-night-intensity contribution of –398,000; the latter does not identify shorter stays. The paper proves conditional accounting and decision results, executes coverage and survey-selection experiments, and enumerates a hypothetical measurement-cost frontier. Compatible expenditure observations can eliminate separate coverage and yield uncertainty from an income comparison, changing which measurements are worth buying. Current public evidence does not identify a national tourism resident-income growth rate. The contribution is an audited Saint Lucia application and an executable measurement protocol, not a new decomposition theorem or a measured retention coefficient. A staged programme assigns institutional owners, release requirements and review rules while preserving an explicit “unresolved” classification.

Keywords: Saint Lucia; tourism recovery; paid person-nights; accommodation coverage; partial identification; visitor expenditure; resident income; statistical capacity.

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“An island can make tourism work better without making every total larger.”

Kevin L. Michel, *Bad Bunny: Your Island Is Not for Sale*, research draft, chapter 5. [1]

What the evidence permits

Saint Lucia should retain arrival counts and paid-night statistics, but attach each to a defined population and reporting period. Neither should substitute for resident earnings or public value. Four conclusions guide this paper.

1. The recovery differs by measure and comparator. Annual arrivals exceeded 2019 in 2024 and 2025, while paid nights remained below it. Both measures declined between 2024 and 2025. The appropriate answer is a dated comparison, not an unqualified declaration that tourism is either growing or failing.
2. The underlying question is stronger than the political claim that prompted it. A reconciled official table authenticates 262,381 arrivals in January–July 2019. The other three disputed endpoints could not be independently authenticated. They are excluded from the principal empirical results.
3. Published nights do not determine resident-income recovery. A change in accommodation use, statistical coverage, spending, domestic production requirements or ownership income can change the relationship. Constructive examples demonstrate opposite income outcomes under identical arrival and published-night paths.
4. Measurement should serve a specified decision. First repair incompatible definitions. Then identify

which missing observation can change the conclusion, cost that collection task, and publish the remaining uncertainty. A more precise survey need not deliver a favourable result.

The immediate recommendation is a CSO-led reconciliation programme working with the tourism department, Saint Lucia Tourism Authority (SLTA), Finance and relevant data custodians. Its first output should be common definitions and a revision bridge. Its next outputs should be a reconciled accommodation frame, a departure-survey comparison pilot and an experimental production-and-resident-income account. Proposed deadlines are measured from a funded start, not presented as existing government commitments.

1. The question and the contribution

Tourism is a sequence of economic transactions, production activities and income distributions. Counting entry episodes describes demand at the border. Counting guest nights describes time in a stated accommodation universe. Measuring visitor spending describes purchases. None of those observations, alone, tells a worker whether real earnings improved, a supplier whether profit rose, or a public authority whether an incentive was worth its cost.

The distinction matters particularly when an economy depends heavily on visitors but has limited capacity to maintain accommodation registers, probability surveys, business accounts and linked income statistics. Apparent contradictions between indicators can reflect real changes in visitor behaviour. They can also arise because the indicators cover different populations or because measurement changes between periods. A useful policy analysis must leave both possibilities open.

The immediate motivation was a United Workers Party statement comparing January–July 2019 and 2026. It supplied arrivals of 262,381 and 268,842 and paid nights of 1,718,900 and 1,588,628. The subtraction is valid, but subtraction does not authenticate inputs or establish the effects on all businesses. This paper focuses on the measurement and policy question raised by the statement. The claim audit is a small part of the evidence architecture, not a test of a political party's character or intentions.

The central question is: when arrivals rise but paid nights fall, what can be established about tourism recovery, real domestic value added and income accruing to residents? A related operational question follows: which additional observation should a small statistical system collect first?

The paper makes three bounded contributions. First, it reconciles several official publication vintages and supplies a reproducible local recovery record. Second, it connects exact descriptive decomposition to explicitly conditional income bounds, including a useful accounting-substitution result: once compatible receipts are measured, separately estimating nights coverage and yield may add no information to the aggregate income comparison. Third, it turns a precision objective into an inspectable finite measurement-design problem and a proposed institutional work programme. The identities, Shapley method, interval arithmetic and finite optimization are established mathematics. Originality is claimed for the documented Saint Lucia application and decision-specific integration, not for those general tools.

The empirical benchmark protocol uses 2019 as the last full pre-pandemic year, the preceding comparable year, and the recent measured annual arrival peak. For the latest complete official year, 2025, the latter two both identify 2024. For a possible January–July 2026 comparison, they identify 2025 and 2024 respectively. Selecting 2019 cannot by itself identify a government's contribution. This paper makes no causal estimate for Allen Chastanet, Philip J. Pierre, a tourism partnership or any individual policy.

2. What is already known

2.1 Demand, duration and unobserved accommodation

Nights are an established tourism measure. The International Recommendations for Tourism Statistics distinguish visitors, trips and nights, and recognize accommodation outside conventional establishment reporting. Two visitors sharing one room for seven nights generate fourteen guest-person nights but seven occupied room nights. Applying a room price to guest nights therefore gives the wrong unit of analysis. National border arrivals also differ from accommodation check-ins: one visitor moving between establishments can generate several property arrivals. [2, 3]

Mussini's decomposition of tourism demand already expresses nights through arrival volume, visitor mix and segment-specific duration, using the logarithmic mean Divisia method. Shorrocks supplies the established order-averaging foundation for exact Shapley allocations. This study uses a simpler two-factor form because the compatible local cells needed for a fuller empirical decomposition were not retrieved. Adding unobserved parameters to an equation does not make them empirically identified. [4, 5]

The measurement of unobserved tourism is also established. De Cantis and colleagues distinguish observed and unobserved nights and trips. Guizzardi and Bernini investigate accommodation underreporting using official demand and supply surveys. Vergori, Colacchio and Suppa offer the closest fully inspected coverage application: reconciling Italian sources requires separating statistical universes and recognizing residual survey effects. A discrepancy is not automatically hidden short-term rentals, deliberate evasion or a constant missing share. [6–8]

Research on duration and spending further cautions against assuming that every extra night has the same economic value. Longer stays and daily expenditure can move differently. Studies of stay duration, including small-island settings, motivate joint measurement of trip spending, night spending and transport intensity; their foreign coefficients are not imported here as Saint Lucia estimates. Platform data partnerships can extend a frame, but bookings, listings, dwellings and operating accommodation units must be deduplicated and reconciled. [9–11]

2.2 Production, income and decision-focused statistics

Tourism satellite accounts reconcile visitor consumption with domestic supply. Tourism direct gross value added is distinct from the gross value added of all accommodation and food-service businesses, and from indirect or induced effects. National accounts distinguish domestic production from income accruing to residents. Research on small-island tourism already treats linkages and local retention as economic questions. The present study does not claim to discover leakage or to replace a tourism satellite account with a multiplier. [12–14]

Partial identification offers a discipline for conclusions that depend on missing information: state the admissible set and determine what every feasible state implies. Robust optimization and statistical decision theory provide established ways to connect uncertainty to actions. Stoye and Manski–Tetenov are decision-theoretic precedents, not tourism calibrations or direct estimators used in this paper. [15–18]

Duverger's 2026 paper is an especially close recent precedent for budget-constrained visitor-spending measurement. Its accessible publisher abstract describes Bayesian historical borrowing and a diagnostic for conflict between historical and current surveys. The full text was restricted. This paper therefore neither claims to introduce budget-aware tourism survey design nor claims to outperform that estimator. Its different objective is to make structural coverage assumptions, accounting dependencies and a recovery-reporting decision explicit. OECD's work on tourism data partnerships reinforces the need for

validated administrative and alternative data, secure access and lasting analytical capacity. [19, 20]

2.3 Scope of the novelty audit

The targeted audit used 34 dated public-web queries on 6 October 2026, followed by primary publisher, official-standard and author-institution retrieval and backward reference inspection. Twenty methodological and literature records were retained with access status. Full text was inspected for the closest decomposition and accommodation-reconciliation papers, official manuals and several foundational methods. Some journal comparisons rely only on their inspected abstracts and metadata. The audit did not use subscription Scopus or Web of Science searches and does not report invented screening counts. Appendix D records the query log and access limits.

No directly matching published Saint Lucia application joining this source reconciliation to this conditional recovery-and-measurement protocol was located. That is a scoped search finding, not proof of global theoretical priority. The contribution remains useful even if another application uses similar bounds: it changes what can responsibly be said from Saint Lucia's published evidence and specifies the measurements needed to improve the answer.

3. Evidence, definitions and revisions

3.1 Data construction

The annual visitor series uses the Ministry of Finance's *Economic and Social Review 2025* (ESR2025), Table 5. The same vintage supplies 2011–2025 arrivals, paid nights and related visitor indicators. Table 2 supplies real accommodation-and-food-services gross value added; Table 7 supplies disjoint source-market categories. The 2025 entries are preliminary. In particular, the output footnote describes quarterly-generated estimates pending the more information-rich annual compilation. [21]

The monthly panel covers every calendar month from 2015 through 2025. It uses the reconciled Finance tables for 2015–2018, 2019–2021 and 2022–2025. These are explicit source-vintage choices, not a claim that one publication contains every month. No missing observation is interpolated. The zero entries in April–June 2020 are printed observations. Monthly paid-night data and matched market-by-accommodation duration cells were not obtained from the retrieved public sources. Consequently, the analysis does not estimate monthly night seasonality or a full market/use/duration decomposition. [21–23]

Revised CSO monthly all-item CPI summaries supply annual arithmetic means. These describe household prices with January 2018 equal to 100. An annual-average CPI is used only for an explicitly labelled purchasing-power diagnostic; it is not a tourism output deflator. Without monthly expenditure weights, that annual calculation is an approximation. December-to-December inflation is not substituted for it. [24–26]

Appendix A includes the complete numerical inputs required by the analysis. Appendix C records source URLs, publishers, periods, dates, archive names, full checksums, coverage and missingness. Source dates marked as catalogue or web-modification dates are not relabelled as exact statistical release dates. The evidence freeze is 6 October 2026.

3.2 Discrepancies are evidence about the record

The CSO online monthly table gives July 2019 as 42,778, whereas the reconciled ESR2023 table gives 42,773. The latter reproduces the 423,736 annual total and the disputed January–July total of 262,381. A different

2019 digest also contains a March value inconsistent with the reconciled monthly series. An older CSO 2020 series differs from the later revised Finance series. The CSO page lacks 2021, but an official Finance table supplies it; this is retrieval of an observation, not imputation. [23, 27, 28]

The older CSO September 2017 value differs by 200 from the reconciled ESR2018 table. The selected Finance monthly series reproduces the annual total. Raw alternative publications are preserved so that the resolution remains visible. For paid nights, the older 2023 value of 2.52 million becomes 2.44 million in ESR2025. Splicing the former into the later series would mix vintages. The published overall mean stay also changes between vintages. These discrepancies do not justify a general claim that official tourism statistics are fabricated; they justify a public revision bridge. [21, 22, 29]

Paid nights are published to two decimal places in millions. Calculated differences therefore inherit rounding. ESR2025 reports a 2025 paid-night decline of 6.7% in the body and table; subtracting displayed 2.58 and 2.41 million produces 6.59%. A summary passage uses 6.8%. The analysis reports the published rate when describing the official statement and the displayed-value rate when reproducing arithmetic, without pretending to recover unrounded counts. [21]

3.3 The 2026 boundary

The January–July 2019 arrival claim is now authenticated by a primary official table. The January–July 2019 paid-night claim and both January–July 2026 claims remain unverified in this review. Their absence from the retrieved public material does not demonstrate that they are false. They are stored as claims and excluded from the principal annual analysis.

An official SLTA release dated 1 June 2026 reports 40,752 April arrivals and positive early-year arrival growth. An SLTA-branded January–June table hosted by Tourism Analytics is separately classified as attributed evidence, rather than silently merged into the primary panel. Neither establishes the disputed January–July paid-night figure. The SLHTA annual report, presented on 17 June 2026, predates the end of July and contains no matching national series. The paper does not annualize partial 2026 observations. [30–32]

4. The recovery record

The full annual path prevents a two-endpoint comparison from hiding the pandemic. Arrivals reached 435,659 in 2024 and then fell to 426,676 in 2025. The latter is 0.69% above 2019. Paid nights reached 2.58 million in 2024 and fell to 2.41 million in 2025, compared with 2.79 million in 2019. Thus arrival recovery relative to 2019 and a more recent decline can both be true. A compound growth rate across the disruption would conceal more than it explains. [21]

The monthly comparison holds the calendar month fixed. It is descriptive, not a seasonally adjusted causal model. The pandemic months remain visible rather than being dropped from the chart. Every selected year's monthly sum reconciles to the annual arrival series. January–July arrivals were 262,381 in 2019, 234,424 in 2023, 274,094 in 2024 and 263,394 in 2025. If the unverified 2026 arrival claim were later authenticated on the same definition, it would be 2.07% above 2025 but 1.92% below 2024. That conditional comparison illustrates the importance of the benchmark; it is not a verified 2026 finding.

4.1 Contrary evidence: real industry GVA can rise despite fewer nights

Real accommodation-and-food-services GVA rises from EC\$1,160.6 million in 2019 to EC\$1,273.7 million in 2025, at 2018 prices, a 9.74% increase. Accommodation alone rises by 10.94%, while food services

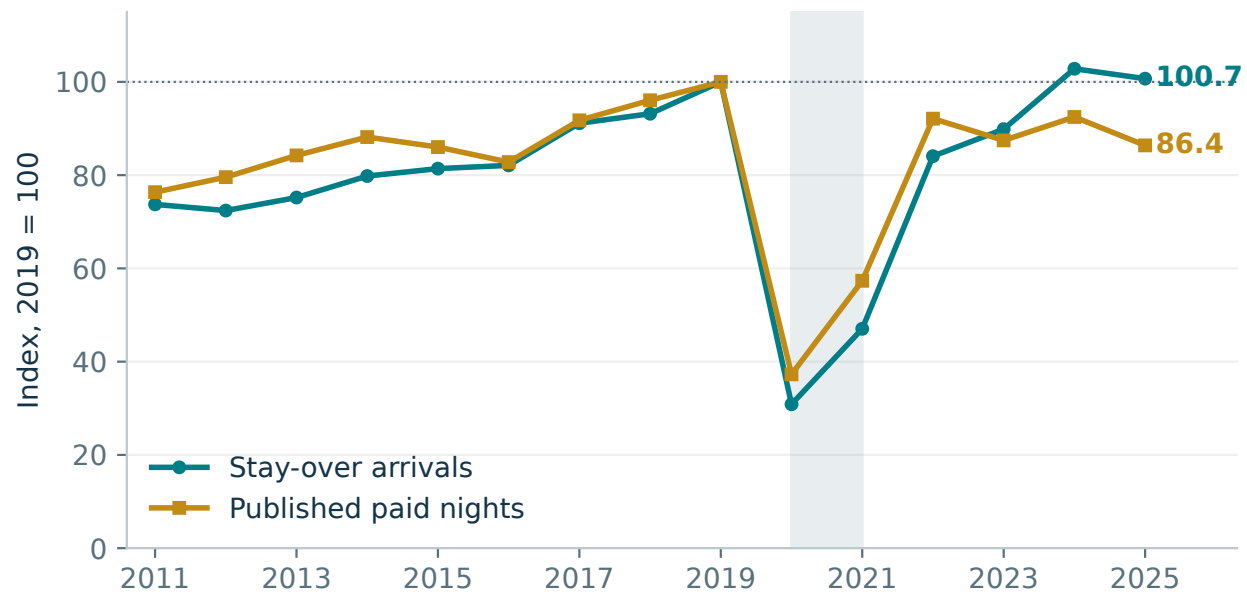


Figure 1: Arrivals and paid nights recover differently. Both lines use ESR2025 Table 5 and a common 2019=100 base; the grey band marks 2020–2021. Paid nights use rounded published levels. The 2025 observations are preliminary. Author's executed calculations.

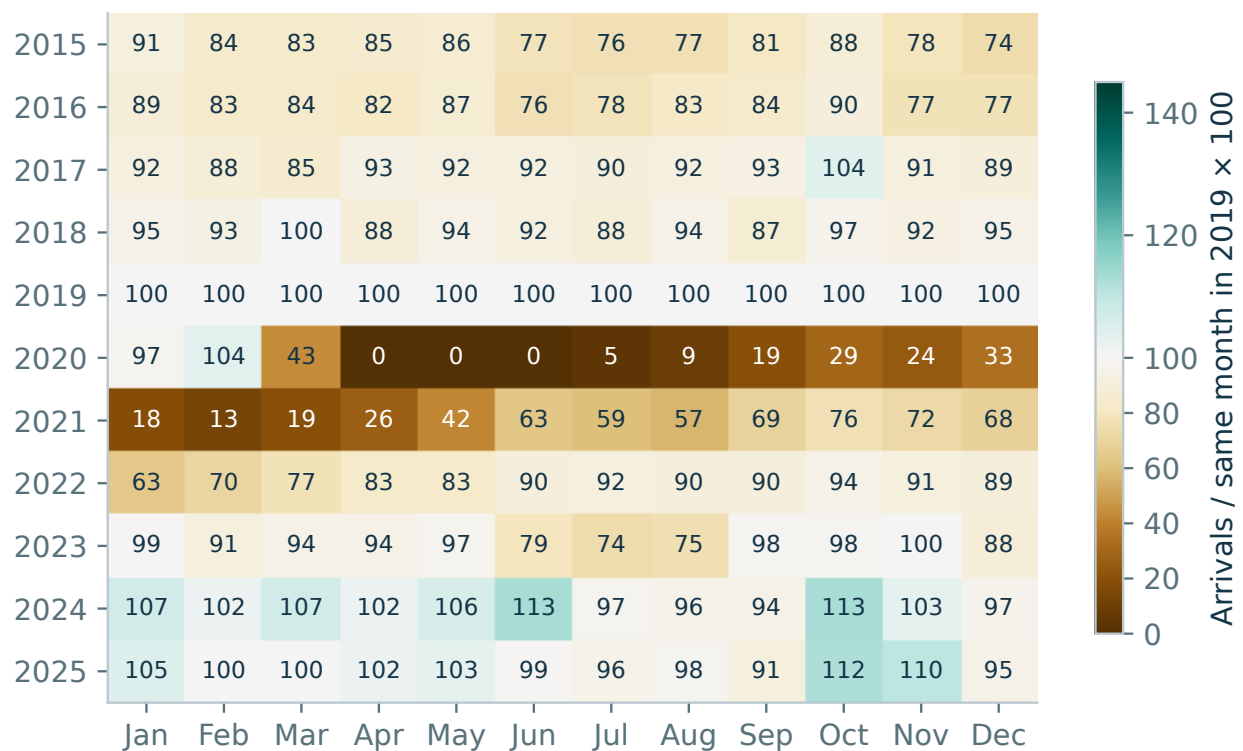


Figure 2: Monthly recovery against the same month of 2019. Each cell is an executed index from official monthly observations; 100 means equal arrivals. The chart retains printed pandemic zeros and does not interpolate. Source-vintage and alternative-publication discrepancies appear in Appendix C.

remain 5.60% below 2019. The combined industry measure falls 4.92% from 2024 to 2025. These results contradict the inference that fewer published nights necessarily mean less real domestic production. They do not identify total tourism direct GVA or tourism-generated resident income: the industries also serve residents and omit visitor activity in other industries. Nor are the preliminary GVA estimates immune from later revision. [12, 21]

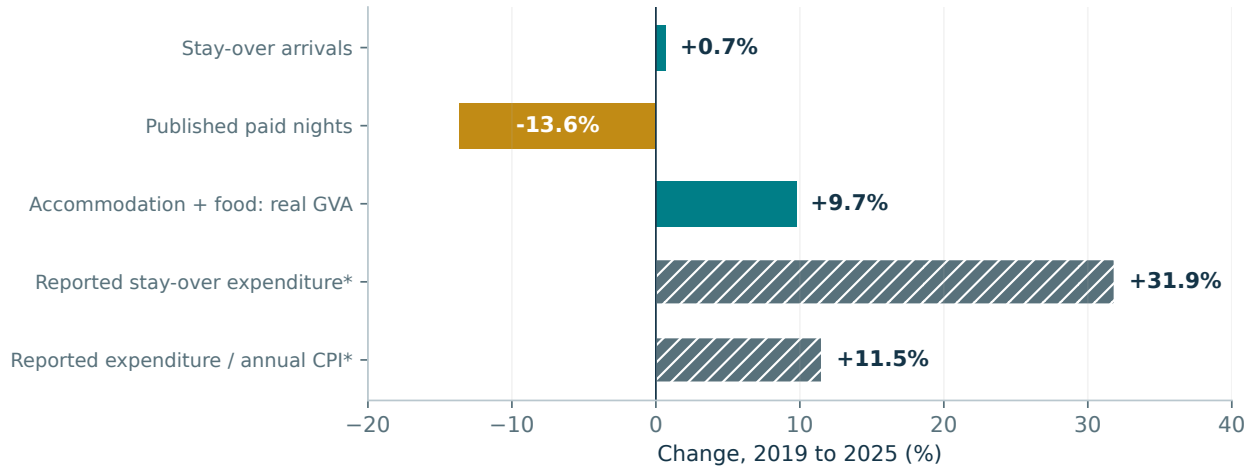


Figure 3: Different measures, different outcomes: 2019–2025. The real GVA bar covers accommodation and food services, not a tourism satellite-account aggregate. Hatched expenditure bars carry a material survey-comparability warning. CPI-deflated reported expenditure is an arithmetic diagnostic, not real tourism GVA or income received by residents.

Reported stay-over expenditure rises from EC\$2,604.5 million to EC\$3,434.5 million, or 31.87%. Annual mean revised CPI rises 18.22%; dividing the reported expenditure flows by those annual means gives an 11.54% purchasing-power increase. This is a mechanical calculation on the published expenditure series, not a verified change in residents' receipts. Survey selection and mode changes can affect the expenditure numerator independently of inflation. The corresponding 2024–2025 diagnostic declines 5.34%. Neither number is converted into an income estimate. [21, 24, 25, 33]

Source-market composition also changes. The United States' arrival share rises from 45.24% in 2019 to 60.50% in 2025; Europe's falls from 23.84% to 17.91% and the Caribbean's from 19.70% to 12.67%. The five disjoint categories, including Canada and Other, sum to total stay-overs. The shift is consistent with composition being relevant, but market-specific compatible paid-use and duration cells are missing. It cannot be assigned a numerical share of the paid-night decline. [21]

4.2 What an exact decomposition can establish

Let A_t denote all stay-over arrivals and O_t the published paid-night value. For $A_t > 0$, define $J_t = O_t / A_t$. Then $O_t = A_t J_t$ exactly. We call J published paid-night intensity per arrival. It can reflect duration, paid-accommodation use, reporting coverage, market composition and timing; it is not a verified average stay.

For a comparison from 0 to 1, define the symmetric contributions

$$\phi_A = (A_1 - A_0)(J_0 + J_1)/2, \quad \phi_J = (J_1 - J_0)(A_0 + A_1)/2. \quad (1)$$

Proposition 1. $\phi_A + \phi_J = O_1 - O_0$.

Proof. Expanding the products cancels the cross terms A_1J_0 and A_0J_1 , leaving $A_1J_1 - A_0J_0$. Equivalently, the formula averages the two replacement orders and divides the interaction term equally. This is the established two-factor Shapley allocation. $\square$

Between 2019 and 2025, J falls from 6.5843 to 5.6483 published paid nights per arrival. Equation (1) allocates the approximately 380,000-night decline to +17,982 nights from the arrival factor and -397,982 from intensity. Between 2024 and 2025, the approximately 170,000-night decline is allocated to -51,968 from arrivals and -118,032 from intensity. These are descriptive allocations based on rounded levels, not estimated behavioural or policy effects.

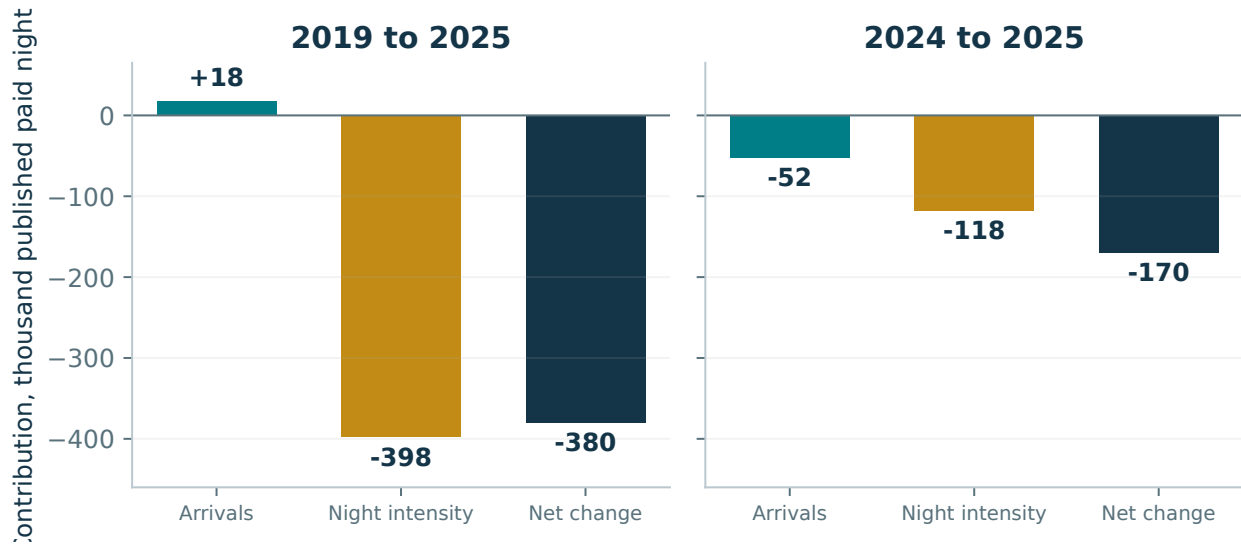


Figure 4: Exact two-factor allocation of the published paid-night change. Values are thousands of nights, rounded for display. “Night intensity” means published paid nights divided by all stay-over arrivals; it does not isolate duration. Components sum to the net change before display rounding.

Under the conventional assumption that each published paid-night level was rounded to the nearest 0.01 million, the 2019–2025 percentage decline ranges from approximately 13.29% to 13.95%. The corresponding intensity contribution ranges from roughly -388,000 to -408,000 nights; the arrival contribution remains approximately +18,000. These are rounding sensitivities, not confidence intervals. The nearest-rounding convention is an explicit assumption because the retrieved table does not document its numerical rounding algorithm.

5. From an identity to an economic account

5.1 When $B = AcL$ is exact

For an arrival cohort C_t , let b_i be the paid person-nights associated with trip i in a specified accommodation universe. Let n_t count cohort members with positive b_i , $c_t = n_t/A_t$, and $L_t = \sum_i b_i/n_t$ for $n_t > 0$. Then

$$B_t^{\text{cohort}} = \sum_{i \in C_t} b_i = A_t c_t L_t. \quad (2)$$

Here c is the share of arriving trips using that universe and L is mean nights in it per participating trip.

A visitor can mix paid and unpaid stays, so L need not equal total trip duration. If the universe is only a surveyed class, c must not be relabelled as the share using any paid accommodation.

Proposition 2 (calendar reconciliation). Let I_t be qualifying nights in calendar period t belonging to earlier arrival cohorts, and F_t nights after period t belonging to the cohort arriving in t . Under a consistent trip/date assignment,

$$B_t^{\text{calendar}} = A_t c_t L_t + I_t - F_t. \quad (3)$$

Proof. Nights in t either belong to earlier arrivals, contributing I_t , or to arrivals during t . The latter cohort has $A_t c_t L_t$ qualifying nights over its complete trips, of which F_t occur later. Subtracting those and adding earlier-cohort nights yields (3). $\square$

Matching January–July with January–July does not make $I - F$ zero. Stays crossing the boundary require either complete cohort accounting or an explicit calendar bridge. This is particularly relevant near closures and reopening periods. Dividing paid nights by arrivals, or by arrivals multiplied by a separately published overall mean stay, cannot identify a paid-accommodation share unless these boundaries match.

Reporting capture is a second distinction. If B_t is the true paid calendar-night quantity and O_t is a partial enumeration without duplicates or false positives, $O_t = k_t B_t$, where k is the night-weighted capture fraction. It differs from the trip-level paid-use share c . If a published statistic is instead a survey-expanded estimate, k can be treated only as an effective multiplicative measurement factor, potentially above one. This paper does not assert that Saint Lucia's official paid-night estimator is a simple undercounting census.

With additive errors the equation becomes $O = kB + e$. The positive-product model below applies to $(O - e)/k$ only when it is positive and e has a justified bound. Arbitrary additive error, zero denominators or negative quantities require level methods. A convenient multiplicative equation is not a universal model of statistical error.

5.2 Why a fuller decomposition is not estimated here

For coherent market cells, an expanded identity is

$$B_t^{\text{cohort}} = A_t \sum_m s_{mt} c_{mt} L_{mt}, \quad \sum_m s_{mt} = 1. \quad (4)$$

One may apply a Shapley allocation to the four blocks A, s, c, L , replacing each complete share vector as a block so that its elements still sum to one. Averaging the marginal contribution over every block-replacement order yields an exact total because each order telescopes from the old value to the new one. The general weight on a subset S preceding block j is $|S|!(K - |S| - 1)!/K!$. A change in the timing residual from (3) remains a separate component. [4, 5]

Level-product Shapley calculations avoid logarithmic singularities when a cell total is zero, but cannot recover an unobserved conditional length or paid-use share in an empty market cell. Hybrid comparisons may require exactly those missing conditionals. The defensible options are observable cell-total decompositions, justified aggregation, explicit bounds or an omitted allocation. This study chooses the latter for market/use/duration effects. At aggregate $A = 0$, J is undefined; it is not set to zero merely to force equation (1) through pandemic months.

5.3 The production and resident-income bridge

For a specified paid-stayer segment, let compatible destination receipts be $E_t = (O_t/k_t)y_t$, where y is receipts per true paid person-night for that same segment and period. Let v be direct domestic GVA attributable to those receipts divided by E , and r be a stated resident factor-income component divided by that direct GVA. With a declared price index P , define

$$G_t = \frac{E_t v_t r_t}{P_t} = \frac{O_t y_t v_t r_t}{k_t P_t}. \quad (5)$$

Equation (5) is a bounded accounting construct, not a compiled tourism satellite account or a current Saint Lucia estimate. Purchaser/basic-price valuation, foreign booking services, imported goods and intermediate consumption must be reconciled before v is meaningful. A nonnegative r bounded by one is imposed only for a specified nonnegative income component; it is not a general SNA law. Losses, net subsidies, cross-border receipts and changes in the chosen pool can invalidate that share representation. The treatment of capital consumption must be stated; this paper's illustrative component is gross, with no claim to net household disposable income.

A compatible departure-survey design estimates expenditure per trip as total weighted trip expenditure divided by total weighted trips, and expenditure per person-night as the same weighted expenditure divided by weighted person-nights for the same eligible trips. The latter is a ratio of totals, not the unweighted mean of each respondent's daily rate. A calendar-production comparison additionally needs the period bridge. The retrieved public series do not supply that matched paid-stayer denominator, so this paper does not publish a national paid-night spending yield or reinterpret expenditure divided by all arrivals as a validated paid-stayer yield.

Domestic production and ownership income require separate treatment. A foreign-owned hotel resident in Saint Lucia creates domestic GVA. Primary income accruing to nonresident owners, including relevant reinvested earnings rather than cash transfers alone, enters the production-to-resident-income bridge. It does not erase the domestic production already counted. The national identity is $GNI = GDP +$ net primary income from abroad; assigning part of that bridge to tourism requires information, not subtraction of the whole economy's external-income debit. [13, 34]

At producer level, output less all intermediate consumption gives value added. A hotel's payment to a local supplier is not an additional dollar of value added on top of that supplier's wages, profit and imported inputs. An indirect-effects account may include the supplier's own value added once; it must not sum supplier turnover with its embedded components. Imported inputs, nonresident booking services and nonresident primary income are distinct flows. A single undifferentiated "leakage" subtraction risks omitting boundaries and counting the same flow twice. [12]

For purchasing-power income, P may be a household-relevant CPI. For real production, use appropriate output/input deflation or national-accounts volume measures. One deflator does not establish both. Taxes, transfers and distribution among households, corporations and government are further steps between factor income and household disposable income. Historical SLPA retention-model coefficients remain assumptions, not measured 2026 conversion rates. The earlier model is a useful policy starting point, but it cannot supply the missing contemporary v and r by citation. [26, 35]

5.4 Other segments and public costs

The paid-stayer component does not cover all tourism. Let U_t collect other nonoverlapping resident-income components, already expressed in the same real units. Then total defined income is $T_t = G_t + U_t$. A synthetic example illustrates the consequence: G falling from 100 to 90 while $U_0 = 20$ and U_1 lies between 10 and 50 produces a total-income ratio between 0.833 and 1.167. A decline in one component does not settle the aggregate.

A separately defined net account may be written $N_t = T_t - C_t$, where C represents net public resource costs in the same real units and under an explicitly chosen boundary. This is not a formula for GDP minus public spending. Taxes can be transfers within a resident welfare boundary; tax expenditures depend on a benchmark and are not cash grants; environmental and congestion effects may require physical constraints or separate valuation. Costs already included in the income bridge must not be deducted again.

For rectangular level bounds, N_t lies between $T_t^- - C_t^+$ and $T_t^+ - C_t^-$. A net ratio is appropriate only with a positive baseline and justified joint constraints. If baseline net benefit is zero or negative, report differences. The executed synthetic cost example has baseline income 100 and cost 10, with follow-up income in $[90,120]$ and cost in $[5,30]$. Net follow-up lies in $[60,115]$ against baseline 90, leaving the sign unresolved. None of these synthetic currency units is a Saint Lucia estimate.

6. Conditional bounds and the observations that matter

6.1 A sharp box result, with its conditions

Let $o = O_1/O_0$ and use capital letters for the ratios of the five other positive factors: $K = k_1/k_0$, $Y = y_1/y_0$, $V = v_1/v_0$, $R = r_1/r_0$, $Q = P_1/P_0$. The real resident-component ratio is

$$H_G = \frac{G_1}{G_0} = o \frac{YVR}{KQ}. \quad (6)$$

Proposition 3 (conditional sharp bounds). If the joint feasible set is the full Cartesian product of the stated strictly positive closed intervals, then

$$H_G \in \left[o \frac{Y^- V^- R^-}{K^+ Q^+}, o \frac{Y^+ V^+ R^+}{K^- Q^-} \right]. \quad (7)$$

Proof. The expression increases in Y, V, R and decreases in K, Q . Therefore its extrema occur at the displayed corners. Joint feasibility makes both corners attainable, proving sharpness. Continuity over the connected positive rectangle supplies all intermediate values. $\square$

The box must be distinguished from the country's empirically supported identified set. If its ranges are selected by the analyst without local validation, (7) is a sensitivity envelope. It is not a confidence interval. Correlation, accounting identities or common survey weights can exclude its corners, making it conservative. Zero or negative factors invalidate the logarithmic representation used below. Sampling confidence sets require a separate simultaneous-coverage argument; individually 95% intervals do not automatically form a 95% joint set. [15, 16]

For the observed rounded annual paid-night ratio $o = 2.41/2.79 = 0.863799$, stable coverage and conversion coefficients require nominal receipts per true paid night to rise 15.77% merely to hold the defined nominal component constant. If household prices move by the revised annual CPI ratio, the

required nominal yield increase becomes 36.86%, holding the other factors fixed. These are conditional break-even requirements, not observed price increases or an assessment of policy success. They also cannot be obtained by dividing all stay-over expenditure by a paid-accommodation-only denominator.

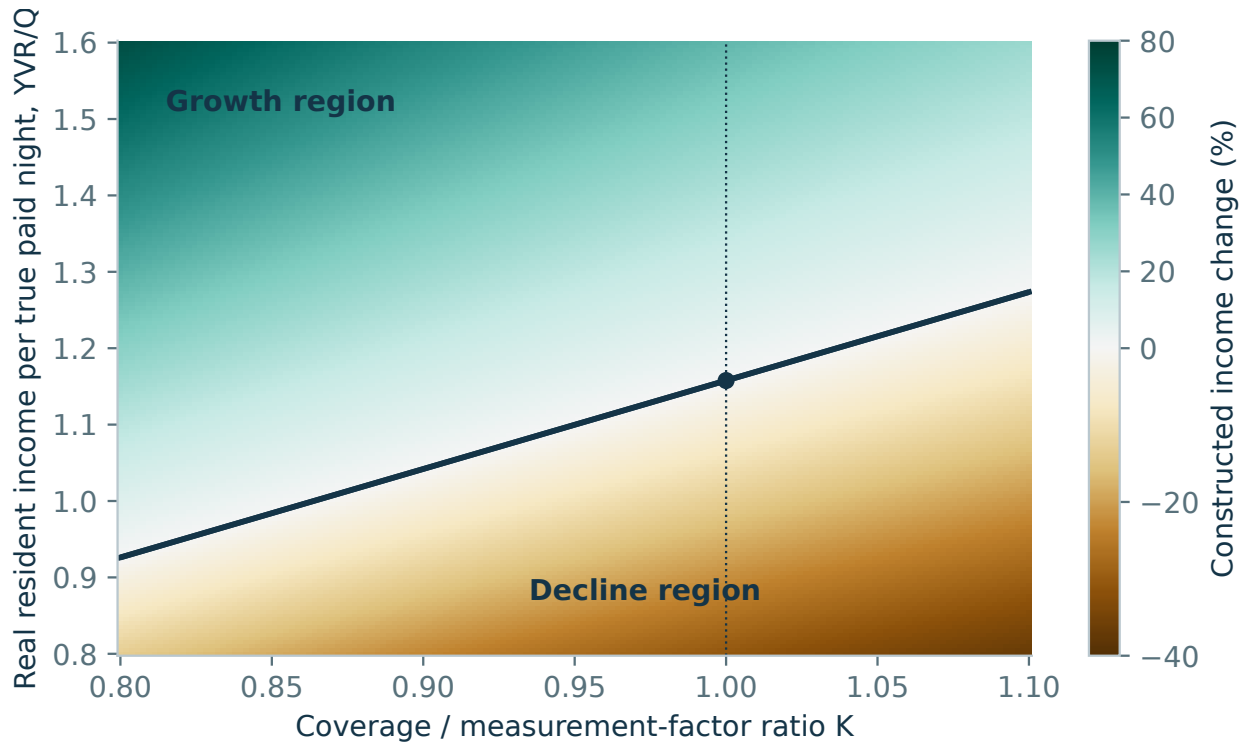


Figure 5: The conditional recovery threshold. The observed annual night ratio anchors the diagram, but the other factors are scenarios. The horizontal axis is K , the change in capture or measurement factor. The vertical axis is combined real resident income per true paid night, YVR/Q . The boundary is $YVR/Q = K/o$; at stable $K=1$, the required ratio is 1.1577.

6.2 A constructive non-identification result

Consider two synthetic economies with arrivals rising from 100,000 to 110,000 and published nights falling from 1,000,000 to 900,000. Baseline capture is complete; yield is 100 currency units per true paid night; the direct-GVA coefficient is 0.6 and the defined resident share 0.8. These three factors are held constant. The follow-up price index is 1.1 against a baseline of 1. Trips are period-aligned, so the timing residual is zero.

In World A, capture remains complete. True nights fall to 900,000 and the real resident component declines 18.18%. In World B, follow-up capture is 0.75. True nights are 1,200,000 and the same income component rises 9.09%. Both worlds have feasible trip identities: with paid-use share 0.8, mean paid nights adjust to the respective totals. They have identical published arrivals and nights but opposite income changes.

This proves non-identification from those two aggregates within the stated model. It does not establish that coverage deteriorated in Saint Lucia. Stable coverage remains a feasible explanation, as do real duration or use changes. The analytical obligation is to identify the observation that distinguishes those explanations.

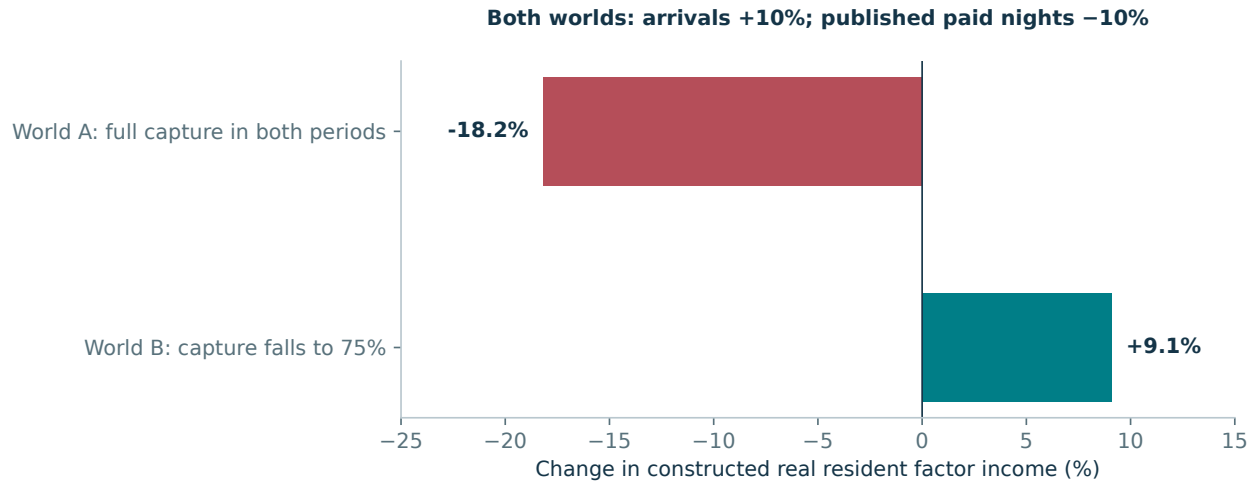


Figure 6: Identical published demand paths, opposite income outcomes. This is a constructed counterexample, not an estimate of Saint Lucia's reporting coverage. Yield and conversion factors are fixed; only follow-up capture differs between the two worlds. Both use the same 10% price increase.

6.3 Compatible receipts can remove an apparent measurement need

Proposition 4 (accounting substitution). If compatible receipts E_t are observed for the same segment and period, and $O_t = k_t B_t$, $y_t = E_t / B_t$, then

$$\frac{O_t}{k_t} y_t = E_t, \quad H_G = \frac{E_1}{E_0} \frac{VR}{Q}. \quad (8)$$

Proof. Substitute $O_t/k_t = B_t$ and cancel B_t against the denominator of y_t . Taking period ratios gives (8). $\square$

Coverage and yield still matter for accommodation management and the interpretation of nights, but if uncertainty about the remaining coefficients is separable from coverage and yield, separately identifying them cannot narrow this particular income bound once their compatible product is fixed. Frame or yield information can still have indirect value when it constrains the remaining coefficients through shared survey or accounting relationships. Treating them as independent unknowns after observing E creates avoidable uncertainty. If receipts themselves have an interval, substitute that interval and its joint constraints; do not assume exact receipts because a point estimate was published.

The cancellation fails when E covers all stay-over visitors but B covers only a paid segment, when booking valuations differ, or when period assignment is incompatible. Saint Lucia's published total expenditure is therefore not automatically inserted into (8) as a validated paid-segment receipt measure. The practical lesson is to repair the common population before purchasing a more detailed decomposition.

An executed illustration uses the observed o only as a scale and hypothetical ranges $K \in [0.85, 1.05]$, $Y \in [1.00, 1.45]$, $V \in [0.85, 1.10]$, $R \in [0.90, 1.10]$ and $Q \in [1.10, 1.30]$. Equation (7) gives $[0.4841, 1.6209]$. Enumerating every corner reproduces it. These ranges can be realized by suitable positive baseline levels, including baseline fraction 0.70 for k, v, r ; that feasibility construction is not a measured retention assumption.

Adding the hypothetical compatible-receipts ratio $E_1/E_0 = 1.10$ yields $[0.6473, 1.2100]$. The code obtains the same result both by direct substitution and by linear optimization over log factors with the accounting

equality $-\log K + \log Y = \log(1.10/o)$. Both intervals span one, so the additional observation improves precision without resolving the direction. This is a useful failure case: more information need not be enough.

7. Survey selection and measurement design

7.1 Why more responses may not repair the estimate

The IMF's 2025 external-sector technical-assistance report records material changes in visitor-expenditure collection: earlier face-to-face collection, email recruitment using the Amber portal, interruption after that portal ceased, and subsequent electronic-form and email arrangements. The report's 2023 sample and response diagnostics are reasons to examine representativeness, not a rule that a small sampling fraction alone makes a survey biased. Its U.S. mirror exercise is a diagnostic scenario, not a universal 14% correction. It transfers trip-expenditure growth to a daily-expenditure comparison and also raises questions about the 2019 baseline. This paper leaves official spending unadjusted and labels its comparability problem. [33]

A synthetic experiment isolates selection. Half the population spends 100 and half 300 units, so the population mean is 200. If response probabilities are 0.8 for low spenders and 0.2 for high spenders, completed respondents have an expected mean of 140. Reversing those propensities produces 260. The experiment draws 20,000 replicate samples of 200 and 800 completed responses in each case, using seed 23197449.

Under low-spender-favoured response, the simulated unweighted mean is 140.06 at 200 responses and 140.01 at 800. Its root mean squared error is 60.21 and 60.06 respectively. More responses reduce random variation while retaining selection bias. An oracle inverse-probability-weighted Hájek mean, using the true propensities known by construction, has simulated means 199.62 and 199.90 and RMSE 8.95 and 4.41. It is a finite-sample ratio estimator, not exactly unbiased. The reverse-selection experiment produces the opposite naive bias; the complete results and Monte Carlo standard errors appear in Appendix B.

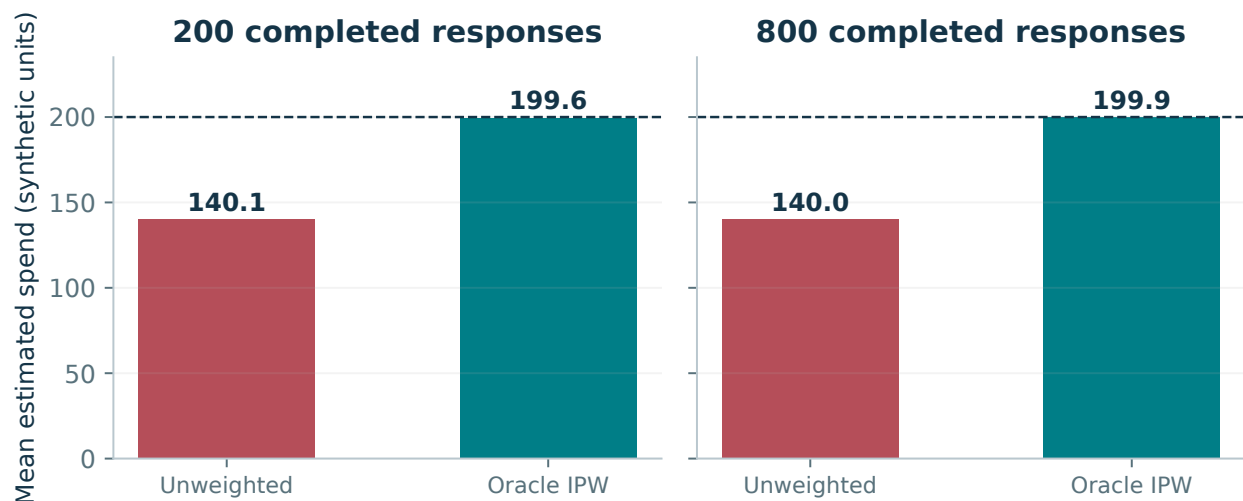


Figure 7: More completed responses do not remove selection bias. Synthetic spending population mean=200; low/high-spender response probabilities=0.8/0.2. Bars are Monte Carlo means over 20,000 replications. "Oracle IPW" uses known response propensities and is not a claim that those probabilities are available in Saint Lucia.

The operational response is a comparison sample with defensible recruitment, response-disposition logging and relevant accommodation/spending strata. Weighting by source country alone cannot guarantee correction if response depends on unmeasured spending within country. The experiment is a mechanism demonstration, not an estimate of the IMF diagnostic's magnitude or a validation of any local weighting scheme.

7.2 A precision budget, not a promised verdict

Write the log income ratio as $z = \log o + \sum_j x_j$, putting denominator factors into signed log form. For an independent interval box $x_j \in [l_j, u_j]$, the full width is $W = \sum_j (u_j - l_j)$. A measurement action a_j has a cost $d_j(a_j)$ and a justified maximum posterior width $w_j(a_j)$ for its factor. Its future centre is unknown. A minimum-cost precision design solves

$$\min_{a_1, \dots, a_m} \sum_j d_j(a_j) \quad \text{subject to} \quad \sum_j w_j(a_j) \leq \epsilon. \quad (9)$$

The budget-constrained version minimizes the width subject to a cost ceiling. A finite menu can be exhaustively enumerated. Shared fieldwork costs, common information and overlapping actions must be represented as bundles or constraints; they cannot be counted as independent savings.

Proposition 5 (precision certificate). If each action guarantees its stated width for every possible returned observation and the valid joint posterior set lies within the resulting interval product, its log-ratio image has width no greater than the sum in (9). Exhaustive enumeration returns a globally least-cost feasible combination.

Proof. The width of the sum over the full Cartesian product equals the sum of its widths. Restricting the feasible set cannot enlarge the image. Enumeration evaluates every admissible candidate, so no cheaper feasible candidate is omitted. $\square$

This result does not establish that a particular sample size will attain the assumed width. Bias, frame coverage and sampling uncertainty require their own evidence. The action-to-precision relationship must be learned from a pilot and validated before the optimization becomes a budget recommendation.

Proposition 6 (precision and a reporting threshold). Let τ be a log-ratio decision threshold. If the true z is at least $\delta > 0$ from τ , and a valid posterior interval containing z has full width $W < \delta$, the entire interval lies on the correct side of τ .

Proof. If $z \geq \tau + \delta$, its lower endpoint is at least $z - W > \tau$. If $z \leq \tau - \delta$, its upper endpoint is at most $z + W < \tau$. Conversely, when $W \geq \delta$, the valid interval $[\tau, \tau + W]$ can contain $z = \tau + \delta$ without lying strictly above the threshold. Thus the strict-width condition is sharp without additional restrictions. $\square$

Without a minimum-distance assumption, no positive finite precision can guarantee a strict growth-or-decline classification for every possible truth near the threshold. A decision programme must permit “unresolved.” It can buy information, not a favourable sign. A log margin $\log(1.10)$ means a ratio at least 1.10 or at most $1/1.10$, not an exactly symmetric plus/minus ten percent band.

7.3 Executed hypothetical measurement frontier

The demonstration uses five factors and three actions per factor, yielding $3^5 = 243$ combinations. No action leaves its initial full log width unchanged; the two collection levels reduce it to 40% and 5%. Hypothetical costs in person-days are: coverage (0,4,9), yield (0,6,13), GVA coefficient (0,10,22), resident

share (0,8,18), and prices (0,2,4). These are transparent algorithm inputs, not quotations from CSO or validated staffing estimates.

The initial full log width is 1.20843. All strongest actions cost 66 hypothetical person-days and reduce it to 0.06042. Under the stipulated attainable widths, the least-cost design satisfying a $\log(1.10)$ separation requirement uses all five strongest actions. A $\log(1.20)$ requirement costs 54 days, using the intermediate GVA-coefficient action and strongest actions elsewhere. Even the 66-day programme cannot meet a $\log(1.05)$ requirement. Appendix B supplies the action table and selected frontier points; the code enumerates every combination and every integer budget.

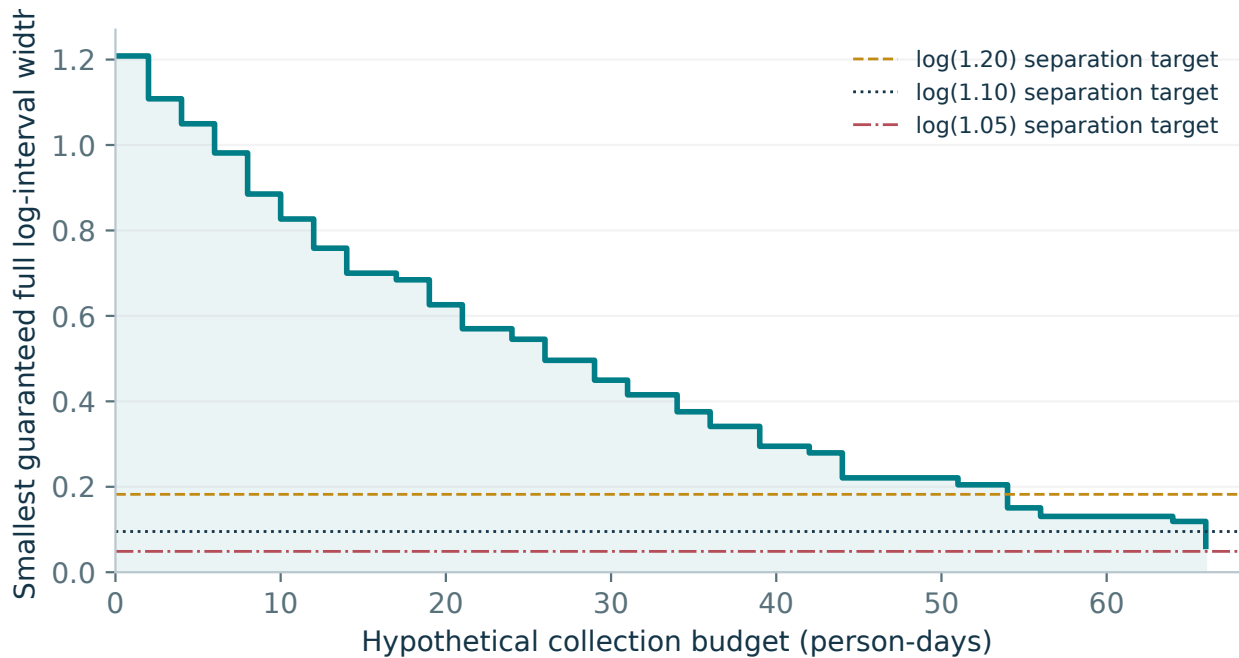


Figure 8: A conditional cost-precision frontier. Costs and attainable widths are wholly hypothetical. The curve minimizes full log-interval width at each budget, without assuming where the observations will place the interval. The horizontal lines are separation targets used in Proposition 6, not confidence levels or forecasts of a favourable result.

If compatible receipts are already known, and the remaining coefficient uncertainty is separable, the appropriate optimization no longer pays separately to resolve K and Y for the aggregate income expression. Where a frame audit also constrains V or R , its indirect information value must remain in the design. The remaining sufficient inputs are the receipt ratio and the V, R, Q account. In the present demonstration, only the separate-factor frontier is priced; no unsupported cost is assigned to a joint receipts survey. A real procurement decision must compare its observed fieldwork cost and attainable uncertainty with the alternative modules. The accounting-substitution result explains why the ranking can change before any sophisticated optimization is run.

8. An executable programme for Saint Lucia

8.1 Use the institutional architecture already available

The Tourism Development Act, No. 1 of 2024, includes a Tourism Information Database and information-collection machinery in Part VIII, sections 146–148. The official April 2024 Gazette lists a commencement

order, and a government notice states commencement on 15 April 2024. A June 2026 order paper subsequently lists an amendment bill. The retrieved materials do not certify the full consolidated legal position after that bill. The first implementation deliverable should therefore be a signed consolidation, commencement and data-sharing review, rather than an unsupported assertion of unrestricted collection powers. Existing low-risk metadata publication need not await a new survey. [36–39]

CSO should own statistical definitions and reconciliation; tourism data custodians and SLTA should supply the operational returns and visitor fieldwork; Finance should convene the decision and resource review. National-accounts and external-sector expertise, including ECCB support where available, should determine the production and resident-income bridge. These are proposed responsibilities, not certifications that every data agreement, staff position or appropriation already exists.

Confidentiality must be designed into the work. Identifiable linkage keys should remain with authorized custodians, with purpose-specific access, minimum fields, a linkage log and a retention/deletion schedule. Public releases should use disclosure-reviewed aggregates. Small-cell counts alone are insufficient: dominance, complementary suppression, repeated-release differencing and local knowledge can also identify respondents. The programme must not promise a statistical/enforcement firewall unless the applicable legal agreement actually provides it. [36, 40]

8.2 Four products with explicit acceptance tests

Monthly physical account. Report border stay-over arrivals, covered nonresident guest-person nights, room nights separately, operating capacity, source/frame version and revision status. Provide a matched-frame bridge when operators enter or leave reporting. The acceptance test is that users can reproduce the published comparison and understand which population changed.

Quarterly visitor-yield account. Collect arrival/departure dates, residence, purpose, party size, accommodation sequence including unpaid nights, spending by category, package/prepayment components and booking channel. Record invitations, contact outcomes and response by relevant strata. Distinguish departing-trip expenditure from calendar production. The acceptance test is a documented sample/weighting procedure, explicit unresolved selection risks and compatible numerator/denominator populations.

Annual experimental production-and-income bridge. Reconcile visitor receipts with output, domestic and imported intermediate inputs, resident compensation, operating or mixed income, capital consumption and nonresident primary-income accrual. Keep direct, indirect and induced effects separate. The acceptance test is a table with named missing bridges and consistent valuation, not a single attractive retention percentage.

Quarterly delivery and distribution card. Track jobs versus persons, hours and real earnings where the survey permits; supplier payment and delivery outcomes; distinct fiscal receipts and relief estimates; and resident service reliability in tourism-intensive areas. Administrative payroll is not automatically total tourism employment, and industry employment is not employment caused by tourism. The acceptance test is a visible link between the intervention, intended beneficiary and measured outcome.

Deadline from funded start	Accountable lead, proposed	Concrete output	Decision enabled
30 days	CSO and tourism Permanent Secretary; Finance convenes	Definition and revision protocol; source inventory; signed legal/data-sharing review; correction route	State which comparisons are supported and authorize feasible collection
90 days	CSO/SLTA research leads and operator-register custodian	Reconciled accommodation frame; comparison departure pilot; nonresponse log; measured staff time and costs	Distinguish coverage from within-frame change; select the next useful measurement
180 days	CSO national accounts/external-sector teams; Finance and authorized custodians	Experimental spending/production bridge; workforce coverage audit; incentive-use linkage feasibility	Test the value account and authorize bounded, evaluable policy pilots
365 days	Finance and Tourism accounting officers; CSO technical signoff	Annual reconciliation pack; independent reproduction; actual costs; keep/change/stop decisions	Scale useful modules, end duplicate collection and fund the next cycle

The programme should ask operators for a fact once, accept secure administrative exports when lawful, retain a short monthly core and rotate the detailed module. Test burden with small guesthouses as well as large hotels. Record supervision, transport/access, translation, cleaning and nonresponse-follow-up costs alongside interview time. The cheapest completed interview may systematically exclude the visitor or business most important to the uncertainty.

8.3 Connect the finding to an intervention

If the problem is coverage, publish a series bridge and repair the frame before describing a reporting change as lost demand. A registry or platform listing is not automatically an operating room, a separate dwelling or a completed stay.

If compatible data establish shorter paid stays, test a longer-stay offer in a bounded market and season. Before launch, define a credible comparison, discount cost, displacement of visitors who would have stayed anyway, supplier and labour outcomes, service capacity and an expiry rule. Gross bookings or a before–after arrival increase do not establish additional resident benefit.

If reported yield rises but resident benefit remains uncertain, collect the wage, input and ownership-income bridge. A supplier-linkage pilot should test reliable contracts, qualification support, aggregation and payment times against delivered local value added and supplier net income. Neither foreign ownership nor local purchasing alone proves the income outcome.

If public services bind, apply resident service floors alongside the financial analysis. Water reliability, waste, access and housing pressure can worsen while private receipts rise. The SLHTA report documents the relevance of industry water, energy and supplier concerns, but does not estimate tourism's incremental effect on household services. Treat those causal links as questions to measure. [32]

If an incentive is due for renewal, disclose its legal basis, purpose, award identifier, actual use, benchmark tax expenditure and feasible alternatives. Conditions and evaluation requirements should be prospective and lawful. Counts of concession orders do not measure revenue forgone, investment additionality or jobs caused. A change in an aggregate income series also cannot establish the return on a particular incentive. [41]

8.4 Governance disciplines that change the work

Institutional Intervention Readiness requires the collection redesign to identify what the current system does, who depends on it and what fallback preserves necessary calibration during transition. RIPPLE-4 directs attention to responses to the chosen metric: a paid-night target may encourage discounts or reporting changes; visitors and firms may adapt; pressure can spread to utilities, suppliers and labour; longer commitments can alter future fiscal and resource exposure. These are mechanisms to investigate, not measured effects supplied by a framework. [42, 43]

PITONS supports a versioned decision record with an owner, evidence boundary, delivery milestones and an explicit adapt/scale/hold/stop rule. It is an independent proposed standard, not an assertion of Government adoption. The related employment-intensity work supports looking beyond output to jobs, hours and earnings; the inflation research supports keeping price periods and purchasing-power questions aligned. These papers supply complementary governance and measurement reasoning. None supplies an observed 2026 tourism retention coefficient. [44–46]

9. Limits, failure cases and what remains unresolved

The principal empirical result is an official-publication audit and descriptive reconstruction. The public evidence retrieved does not contain a monthly national paid-night panel, a fully documented current reporting frame, a matched market/accommodation/stay matrix, a contemporary compiled TSA bridge, or an ownership-linked tourism resident-income account. This is a statement about retrieved evidence, not proof that agencies possess no unpublished information.

The method deliberately fails to declare an income direction when the feasible range crosses the threshold. Its illustrative intervals are not local estimates; its action costs and attainable widths are hypothetical; and the survey experiment knows propensities that a real statistical office must estimate or bound. A hypothetical coverage decline demonstrates possibility, not its occurrence. Independently feasible endpoints can become infeasible under accounting or common-source constraints. Positive-product methods cannot silently absorb negative net income, unrestricted additive error or mismatched periods.

The expenditure series spans survey-method changes. Deflation cannot repair those changes. The 2025 GVA estimate is preliminary, and industry GVA is neither all tourism nor solely tourism. A national income gain could coexist with losses for particular workers, districts or households; average CPI also need not represent their individual consumption baskets. Fiscal and environmental costs cannot be made commensurate merely by inserting an arbitrary deduction.

The literature audit is targeted and access-limited. It supports a restrained application claim, not a claim to have exhausted every relevant paper. Comparative destinations are used as methodological precedents rather than merged into an international ranking, because populations, reporting frames and vintages were not sufficiently harmonized for that purpose. A causal policy evaluation would require a separate identification design and usable treatment/comparison data.

10. Conclusion: a reporting rule and an action rule

Saint Lucia's annual arrivals recovery is real in the published record, but it does not settle the paid-night, production or resident-income questions. The same record shows fewer paid nights than in 2019 and higher preliminary real accommodation-and-food-services GVA. Exact decomposition locates the accounting divergence in published-night intensity, while the data do not separate duration, use, coverage and timing. Three disputed January–July endpoints remain unauthenticated; the 2019 arrival endpoint is verified.

The contribution established here is a reconciled, reproducible local evidence base and a worked decision protocol. The protocol preserves accounting populations, demonstrates conditional bounds and their failure cases, uses compatible receipts to eliminate redundant uncertainty, and connects a validated precision target to a finite measurement choice. The mathematical ingredients are standard; their use here makes a practical public-statistics problem inspectable.

Reporting rule: for a declared target and comparator, report a gain only when the defensible lower ratio bound exceeds one, a decline only when the upper bound is below one, and “unresolved” otherwise. State whether the bounds come from evidence, maintained assumptions or an illustrative scenario.

Action rule: publish the common definitions now; pilot the missing measurements; price their actual full cost; and collect the observation that can change the decision. Where the economic case remains unresolved, use reversible, bounded interventions with service constraints, credible comparisons and review dates. Scale support when additional resident benefit is demonstrated against a feasible alternative, not merely when an arrival or night target is met.

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- [42] Kevin L. Michel (2026). Beyond Chesterton’s Fence: Institutional Intervention Readiness in Complex Policy Systems. Saint Lucia Policy Analysis. <https://doi.org/10.5281/zenodo.21893059>
- [43] Kevin L. Michel (2026). Beyond the First Ripple: RIPPLE-4 as a Mechanism-Based Recursive Policy-Appraisal Framework for Small Open States. Saint Lucia Policy Analysis. <https://doi.org/10.5281/zenodo.21838896>
- [44] Kevin L. Michel (2026). The PITONS Standard: Public Value, Delivery and Learning for Saint Lucia. Saint Lucia Policy Analysis. <https://doi.org/10.5281/zenodo.22080931>
- [45] Kevin L. Michel (2026). From Output Recovery to Employment Gains: Sectoral Employment Intensity and Uneven Labour-Market Recovery in Saint Lucia, 2008–2025. Saint Lucia Policy Analysis. <https://doi.org/10.5281/zenodo.21908801>
- [46] Kevin L. Michel (2026). The Inflation That Remained: Sources and Retention of Consumer-Price Increases in Saint Lucia, 2019–2025. Saint Lucia Policy Analysis. <https://doi.org/10.5281/zenodo.21923881>

Appendix A. Complete numerical inputs

These transcriptions, the explicit synthetic constants and the code in Appendix E reproduce the numerical findings without access to confidential data. The PDF also contains an embedded reproducibility ZIP with machine-readable inputs and scripts; the printed tables remain usable independently. Blank source cells are shown as NA. Dates, measurement boundaries and revisions are part of the inputs, not optional annotations.

A1. Common-vintage annual visitor indicators

ESR2025 Table 5. Nights are million paid person-nights; expenditure is nominal EC\$ million; occupancy is percent; published mean stay is days. These columns are not assumed to share the population required to interpret nights/arrivals as mean stay.

Year	Arrivals	Paid nights	Expenditure	Occupancy	Mean stay
2011	312404	2.13	1500.0	58.3	8.9
2012	306801	2.22	1553.4	62.3	8.5
2013	318626	2.35	1712.7	64.6	8.9
2014	338158	2.46	1960.2	68.4	8.8
2015	344908	2.4	2012.7	70.0	8.7
2016	347872	2.31	1914.5	61.7	8.5
2017	386127	2.56	2134.8	NA	8.3
2018	394780	2.68	2342.9	NA	8.4
2019	423736	2.79	2604.5	71.1	8.0
2020	130781	1.04	NA	37.3	8.8
2021	199347	1.6	1524.1	48.8	8.7
2022	356237	2.57	2841.4	70.4	8.7
2023	380791	2.44	3067.6	69.1	7.9
2024	435659	2.58	3603.9	73.4	7.4
2025	426676	2.41	3434.5	71.7	7.2

A2. Industry GVA and annual prices

Industry values are EC\$ million at constant 2018 prices, ESR2025 Table 2. Published components may differ from their sum because of rounding; combined values are preserved. CPI is the arithmetic mean of the revised monthly all-item indices below.

Year	Accommodation + food	Accommodation	Food services	Annual mean CPI
2019	1160.6	1076.7	83.9	101.342500
2020	408.3	341.0	67.2	101.490833
2021	640.9	584.7	56.2	105.334167
2022	1075.0	1003.7	71.3	115.530833
2023	1209.8	1134.4	75.3	120.010000
2024	1339.6	1259.7	79.9	119.000000
2025	1273.7	1194.5	79.2	119.810000

A3. All 132 monthly arrival observations

Selected source vintages: ESR2018 for 2015–2018, ESR2023 for 2019–2021, ESR2025 for 2022–2025. Every selected monthly sum reconciles to the annual total. No interpolation is used.

Year	Jan	Feb	Mar	Apr	May	Jun
2015	31541	32083	34595	31200	29658	26347
2016	30661	31637	35069	30104	29813	25855
2017	31649	33402	35427	34322	31436	31312
2018	32755	35536	41741	32555	32277	31318
2019	34546	38166	41674	36828	34354	34040
2020	33675	39638	18086	0	0	0
2021	6357	4870	8004	9555	14339	21357
2022	21864	26828	32119	30661	28618	30694
2023	34066	34638	39318	34539	33339	27028
2024	36863	38837	44561	37588	36375	38394
2025	36196	38062	41601	37546	35413	33646

Year	Jul	Aug	Sep	Oct	Nov	Dec
2015	32481	27822	17468	23745	25821	32147
2016	33381	29991	18169	24251	25254	33687
2017	38291	33400	20049	27967	29962	38910
2018	37844	34168	18745	25991	30422	41428
2019	42773	36342	21608	26923	32913	43569
2020	1959	3261	4122	7890	7766	14384
2021	25440	20569	14896	20545	23678	29737
2022	39145	32618	19527	25382	29952	38829
2023	31496	27366	21142	26475	32887	38497
2024	41476	34895	20273	30408	33883	42106
2025	40930	35596	19698	30217	36255	41516

A4. Revised CPI inputs

January 2018=100. These annual-flow diagnostics use the arithmetic mean of all twelve months, not a December-to-December inflation rate. Data extend to 2025 for the core analysis.

Year	Jan	Feb	Mar	Apr	May	Jun
2019	102.23	102.06	101.52	100.32	100.75	100.82
2020	101.17	101.2	100.57	100.16	100.26	100.54
2021	102.87	103.27	102.75	103.38	104.58	105.11
2022	111.52	111.65	112.51	112.74	113.74	114.93
2023	119.32	120.23	120.46	120.02	119.29	119.65
2024	120.18	120.7	118.75	118.04	118.0	117.64
2025	120.37	120.88	119.9	119.76	119.15	119.98

Year	Jul	Aug	Sep	Oct	Nov	Dec
2019	101.5	101.46	101.73	101.69	101.45	100.58
2020	101.19	101.67	102.43	102.76	102.92	103.02
2021	105.83	106.41	106.92	106.75	107.52	108.62
2022	116.64	117.5	117.88	118.46	119.29	119.51
2023	119.48	119.91	120.6	120.84	120.46	119.86
2024	118.9	118.69	118.04	118.04	120.03	120.99
2025	119.61	119.8	119.47	119.55	119.38	119.87

A5. Disjoint source markets used in the comparison

ESR2025 Table 7; Europe includes its published subcategories, which are not added again. “Origin” is the source wording and should not silently be redefined as citizenship.

Year	USA	Canada	Europe	Caribbean	Other
2019	191719	40872	101018	83493	6634
2024	247191	35709	92338	54095	6326
2025	258156	32355	76416	54051	5698

A6. Claims and partial 2026 evidence

Period / measure	Value	Status
Jan–July 2019 arrivals	262381	Authenticated: ESR2023 Table 6
Jan–July 2019 paid nights	1718900	Claim; unverified
Jan–July 2026 arrivals	268842	Claim; unverified
Jan–July 2026 paid nights	1588628	Claim; unverified
April 2026 arrivals	40752	Official SLTA release, 1 June 2026

The screenshot source was supplied for the earlier investigation. Its relative timestamp and truncated Facebook address do not authenticate a permalink or publication date. It is archived as a claim source. Conditional arithmetic yields +2.46245% arrivals and –7.57880% paid nights, and an 8.20028% nominal-yield break-even increase. These values are excluded from the principal national results.

Attributed 2026 month	Arrivals
1	37651
2	38576
3	42105
4	40752
5	35667
6	33340

The latter table is SLTA-branded but hosted by Tourism Analytics. It is retained separately and is not substituted for the direct primary monthly panel.

Appendix B. Executed results and experiment specification

B1. Descriptive allocations

Comparison	Arrival contribution	Intensity contribution	Total change
2019–2025	17981.925342	-397981.925342	-380000
2024–2025	-51968.347581	-118031.652419	-170000
2019–2024	74556.612847	-284556.612847	-210000

Units are published paid person-nights, computed from rounded million-night inputs. Excess decimal places here support reproduction, not a claim of observational precision. The manuscript rounds the allocations appropriately.

B2. Survey-selection experiment

Seed=23197449; 20,000 replications in every row. Population spend is 100 or 300 with equal shares; n counts completed responses. IPW is the oracle normalized Hájek estimator. MCSE is the Monte Carlo standard error of the reported mean, not uncertainty about Saint Lucia spending.

n	Low/high response	Estimator	Mean	Bias	RMSE	MCSE
200	0.8/0.2	Naive	140.0591	-59.9409	60.2117	0.04034
200	0.8/0.2	Oracle IPW	199.6156	-0.3844	8.9526	0.06325
200	0.2/0.8	Naive	259.9222	59.9222	60.1912	0.04019
200	0.2/0.8	Oracle IPW	200.3520	0.3520	8.9238	0.06305
800	0.8/0.2	Naive	140.0076	-59.9924	60.0584	0.01991
800	0.8/0.2	Oracle IPW	199.8956	-0.1044	4.4086	0.03117
800	0.2/0.8	Naive	260.0010	60.0010	60.0676	0.01999
800	0.2/0.8	Oracle IPW	200.1188	0.1188	4.4261	0.03129

B3. Hypothetical factor and action inputs

Factor bounds, person-day costs and reductions are entirely assumed for the methods demonstration. None is a measured national parameter or a quoted collection budget. Each action reduces the original full log width to 100%, 40% or 5%, respectively.

Factor ratio	Lower	Upper	Initial full log width	Costs: 0 / 1 / 2
K	0.85	1.05	0.211309	0 / 4 / 9
Y	1.0	1.45	0.371564	0 / 6 / 13
V	0.85	1.1	0.257829	0 / 10 / 22
R	0.9	1.1	0.200671	0 / 8 / 18
Q	1.1	1.3	0.167054	0 / 2 / 4

Budget	Least full log width	Actions K,Y,V,R,Q
0	1.208427	0,0,0,0,0
10	0.826787	0,1,0,0,2
20	0.626043	2,1,0,0,2
30	0.449552	1,2,0,1,2
40	0.294854	1,2,1,1,2
50	0.220896	2,2,1,1,2
54	0.150662	2,2,1,2,2
60	0.130656	2,2,2,1,2
65	0.118890	2,2,2,2,1
66	0.060421	2,2,2,2,2

All 243 action combinations were evaluated. The smallest possible width is 0.060421327. A strict $\log(1.05)=0.048790164$ target is infeasible; $\log(1.10)=0.095310180$ requires 66 days; $\log(1.20)=0.182321557$ requires 54 days. These are conditional precision certificates. All future intervals must be recentered on the actual observations.

Appendix C. Source and revision audit

C1. Primary numerical and claim sources

All entries were retrieved on 6 October 2026. SHA-256 identifies the archived bytes. Archive names are relative to the reproducibility source record. Multiple table records can legitimately share a PDF/hash. Undated material is not assigned a fabricated release date.

esr2025_t5. Economic and Social Review 2025: Selected Visitor Statistics. Government of Saint Lucia, Department of Finance, Research and Policy Unit. URL: <https://www.finance.gov.lc/resources/download/2256>. Reference period: 2011–2025. Release/date status: 2026-03-23 (resource catalogue timestamp; not a separately dated statistical release). Locator: Appendix Table 5, printed page 104, PDF viewer page 121 (zero-based 120); tourism chapter pages 22–27.

Units and population: persons/visits; paid bednights in millions; EC\$ million nominal; days; percent; Stay-over tourists; paid hotel nights; estimated stay-over spending; hotel occupancy. Coverage: Table 5 nights are described as paid hotel bednights in the tourism chapter. The exact establishment reporting frame is not supplied. Revisions: 2019 and 2024 marked revised; 2025 preliminary. Hotel classifications amended from 2019. Missingness: 2020 spending unavailable; 2017–2018 occupancy unavailable; cruise spending unavailable from 2018.

Archive: sources/esr2025.pdf. SHA-256: b110db2e4e79800768376619aa1a762e3fda065ea6bb404c71e43e700f03369c.

esr2025_t6. Economic and Social Review 2025: Monthly Arrivals by Category. Government of Saint Lucia, Department of Finance, Research and Policy Unit. URL: <https://www.finance.gov.lc/resources/download/2256>. Reference period: 2022–2025. Release/date status: 2026-03-23 (resource catalogue timestamp; not a separately dated statistical release). Locator: Appendix Table 6, printed page 105, PDF viewer page 122 (zero-based 121).

Units and population: Stay-over arrival events / person-visits; Nonresident stay-over tourists. Coverage: Monthly arrivals, distinct from a calendar flow of guest-nights. All published months retained. Revisions: 2024 revised; 2025 preliminary. Missingness: No month missing in 2022–2025.

Archive: sources/esr2025.pdf. SHA-256: b110db2e4e79800768376619aa1a762e3fda065ea6bb404c71e43e700f03369c.

esr2025_t7. Economic and Social Review 2025: Stay-over Tourist Arrivals by Country of Origin. Government of Saint Lucia, Department of Finance, Research and Policy Unit. URL: <https://www.finance.gov.lc/resources/download/2256>. Reference period: 2012–2025. Release/date status: 2026-03-23 (resource catalogue timestamp; not a separately dated statistical release). Locator: Appendix Table 7, printed page 106, PDF viewer page 123 (zero-based 122).

Units and population: Stay-over arrival events / person-visits; Stay-over tourists grouped by origin. Coverage: Top-level USA, Canada, Europe, Caribbean and Other categories are disjoint; European subgroups are not added again. Revisions: 2025 preliminary; earlier flags as published. Missingness: No market-specific paid nights, duration or spending table retrieved.

Archive: sources/esr2025.pdf. SHA-256: b110db2e4e79800768376619aa1a762e3fda065ea6bb404c71e43e700f03369c.

esr2025_t2. Economic and Social Review 2025: Gross Domestic Product by Economic Activity at Constant 2018 Prices. Government of Saint Lucia, Department of Finance, Research and Policy Unit. URL: <https://www.finance.gov.lc/resources/download/2256>.

[//www.finance.gov.lc/resources/download/2256](https://www.finance.gov.lc/resources/download/2256). Reference period: 2006–2025. Release/date status: 2026-03-23 (resource catalogue timestamp; not a separately dated statistical release). Locator: Appendix Table 2, printed page 101, PDF viewer page 118 (zero-based 117).

Units and population: EC\$ million at constant 2018 prices; Resident producer units in the accommodation and food-services industries. Coverage: Industry GVA includes services purchased by residents and excludes visitor purchases in other industries. It is not tourism direct GVA. Revisions: 2006–2024 revised; 2025 preliminary and based on quarterly estimates. Missingness: Tourism shares and ownership-linked resident-income allocations are not provided.

Archive: [sources/esr2025.pdf](#). SHA-256: b110db2e4e79800768376619aa1a762e3fda065ea6bb404c71e43e700f03369c.

esr2023_t6. Economic and Social Review 2023: Monthly Arrivals by Category. Government of Saint Lucia, Department of Finance, Research and Policy Unit. URL: <https://www.finance.gov.lc/resources/download/2208>. Reference period: 2019–2023. Release/date status: 2024-04-30 (resource catalogue timestamp). Locator: Appendix Table 6, printed page 108, PDF viewer page 123 (zero-based 122).

Units and population: Stay-over arrival events / person-visits; Nonresident stay-over tourists. Coverage: All months selected for 2019–2021; ESR2025 provides the newer 2022–2025 data. Revisions: 2021 and 2022 revised; 2023 preliminary. Missingness: No missing monthly stay-over values in 2019–2021; April–June 2020 are explicitly zero.

Archive: [sources/esr2023.pdf](#). SHA-256: 3cb591fdae068280ca36325bfa0f6c4871c56b6640c10d392521e6c952344bf0.

cso_monthly. Tourist Arrivals Monthly 2010 to 2023. Central Statistical Office of Saint Lucia; underlying sources SLTB, SLASPA and CSO. URL: <https://stats.gov.lc/subjects/economy/tourism/tourist-arrivals-monthly-2010-to-2023/>. Reference period: 2010–2023. Release/date status: 2024-05-16 (table last-updated date). Locator: Main HTML table, twelve month rows and annual total.

Units and population: Stay-over arrivals; Tourists recorded in the published table. Coverage: Retained for revision audit only; ESR2018 provides canonical 2015–2018 observations. Revisions: 2017 monthly sum 386,327 versus stated 386,127; July 2019 is 42,778 versus ESR 42,773; older 2020 total 130,695 versus revised 130,781. Missingness: The entire 2021 column is missing (...); it is not imputed.

Archive: [sources/cso_monthly_2010_2023.html](#). SHA-256: e448e373be342c57adfe2568959e662abea501a060863a57f5ab759d3f428bb8.

cso_selected. Selected Visitor Statistics, 2012 to 2023. Central Statistical Office of Saint Lucia. URL: <https://stats.gov.lc/subjects/economy/tourism/selected-visitor-statistics-2012-to-2023/>. Reference period: 2012–2023. Release/date status: 2024-05-16 (table last-updated date). Locator: Main HTML table.

Units and population: Arrivals; million paid nights; EC\$ million; days; percent; Published tourism indicators. Coverage: Used for the revision audit only. Revisions: 2020 nights: 1.01 versus ESR2025 1.04 million. 2023 nights: 2.52 versus ESR2025 2.44 million. 2019 mean stay: 8.1 versus ESR2025 8.0 days. Missingness: 2020 expenditure missing; selected occupancy cells unavailable.

Archive: [sources/cso_selected_2012_2023.html](#). SHA-256: f6704019d5ea4f03304fb6292744b407171e1be267ec7af128d111a9aafec10.

cso_cpi2018_2021. CPI Summary – Monthly Release – 2018 to 2021 (Revised). Central Statistical Office of Saint Lucia. URL: <https://stats.gov.lc/subjects/economy/prices-and-price-indices/cpi-summary->

[monthly-release-2018-to-2021/](#). Reference period: 2018–2021. Release/date status: Separate release date not stated; webpage modified 2026-04-21.. Locator: All Item Index monthly rows.

Units and population: Index: January 2018 = 100; weights labelled February 2016.; Household consumption basket. Coverage: All-items CPI is used as a consumption purchasing-power deflator, not as a tourism production price index. Revisions: Explicitly revised summary; preferred to unreconciled standalone annual pages. Missingness: No missing months in 2019–2021.

Archive: [sources/cso_cpi_revised_2018_2021.html](#). SHA-256: 0531bb109610bb19eeff11c05ef729beae20849ff6d65691936f6b7813a2d36e.

[cso_cpi2022_2026](#). CPI Summary – Monthly Release – 2022 to 2026 Q2 (Revised). Central Statistical Office of Saint Lucia. URL: <https://stats.gov.lc/subjects/economy/prices-and-price-indices/cpi-summary-monthly-release-2022-to-2026-q2/>. Reference period: 2022–June2026. Release/date status: Separate release date not stated; see webpage metadata.. Locator: All Item Index monthly rows.

Units and population: Index: January 2018 = 100; weights labelled February 2016.; Household consumption basket. Coverage: All-items CPI. Complete annual observations 2022–2025; only January–June available for 2026. Revisions: Explicitly revised summary; annual means round to ESR2025 Table 30 values for 2023–2025. Missingness: No missing months in 2022–2025; 2026 after June absent.

Archive: [sources/cso_cpi_revised_2022_2026.html](#). SHA-256: 9045bfcba5f5cd6dde60ac86e840c11044ba37a34d40544e3304be05d6cb1d0d.

[slta_april2026](#). Unprecedented April growth for Saint Lucia tourism in 2026. Saint Lucia Tourism Authority / Government of Saint Lucia. URL: <https://tourism.govt.lc/news/unprecedented-april-growth-for-saint-lucia-tourism-in-2026>. Reference period: April 2026 and January–April 2026. Release/date status: 2026-06-01. Locator: Dated news release body.

Units and population: Stay-over arrivals and percentage change; Stay-over tourists. Coverage: April 40,752 and 8.5% year-on-year growth; January–April growth 3.7%. All monthly levels are not supplied. Revisions: Revision status not stated. Missingness: No July data or paid nights.

Archive: [sources/slta_april_2026.html](#). SHA-256: d451ccefc33a975a56c301c9554901f9e02b4f404d04a03c0543c98fb1f7813fe.

[ta_june2026](#). Saint Lucia: Stayover Arrivals by Month, June 2026. Tourism Analytics (secondary host); table attributes SLTA. URL: https://tourismanalytics.com/uploads/1/2/0/4/120443739/slu-month-june-2026_orig.png. Reference period: January–June 2026. Release/date status: Not stated; discussed in a host article dated 2026-08-01.. Locator: Full image of monthly table.

Units and population: Stay-over arrivals; Stay-over tourists. Coverage: Preliminary six-month table with SLTA attribution, not retrieved from an SLTA-controlled URL. Revisions: Preliminary. Missingness: July 2026 not available.

Archive: [sources/slta_attributed_june2026.png](#). SHA-256: ad3908d41a831da36f517144a8d96c054696cf64e8c7b6b3d0af1815091766a7.

[ta_page](#). Saint Lucia Tourism Performance Statistics 2026. Tourism Analytics. URL: <https://tourismanalytics.com/saintlucia-statistics.html>. Reference period: Various historical and current tourism tables. Release/date status: Not stated; rolling page.. Locator: Historical monthly table and linked images.

Units and population: Various tourism statistics; Arrivals and accommodation records in linked tables. Coverage: Secondary host with attributed source images. Revisions: Various vintages. Missingness: Not

a continuous primary panel.

Archive: sources/tourism_analytics.html. SHA-256: 7d9912ebacfb2e217ecc031f66a02be878ceaa67f385274b37eb3c303070938c.

slhta202526. SLHTA Annual Report 2025/26. Saint Lucia Hospitality and Tourism Association. URL: https://slhta.com/wp-content/uploads/2026/06/SLHTA-Annual-Report-2025-26_compressed.pdf. Reference period: 2025/26 association year. Release/date status: 2026-06-17 (presented at the annual general meeting). Locator: PDF page 4 presentation date; pages 29–34 policy work.

Units and population: Association activity narrative and EC\$ financial statements; Association membership and its own finances. Coverage: Industry account of water, energy, workforce and supplier constraints. Revisions: Not a national statistical release. Missingness: No exact four disputed endpoints or January–July 2026 paid-night series.

Archive: sources/slhta202526.pdf. SHA-256: 58ed75322c749aad577ec7ca4406fa8251cd8fc9222a6959afc368086ec4b843.

digest2019. Annual Statistical Digest 2019. Central Statistical Office of Saint Lucia. URL: <https://stats.gov.lc/wp-content/uploads/2021/06/Annual-Statistical-Digest-2019.pdf>. Reference period: 2019. Release/date status: 2021-06 (URL upload month); exact release date unconfirmed.. Locator: Table 9.3.

Units and population: Monthly stay-over arrivals; Tourists. Coverage: Older primary publication retained for revision audit. Revisions: March 2019 shows 44,671 rather than ESR 41,674; July shows 42,773. Missingness: Monthly sum does not match the stated annual total.

Archive: sources/digest2019.pdf. SHA-256: 48e6dfe8b46535313ea1a0f13a3f4ae55015bfad33948748bcd46ad69dcbf227.

uwp_screenshot. More Visitors. Fewer Bed Nights. (user-supplied Facebook post screenshot). United Workers Party (Saint Lucia) Facebook page, as displayed. URL: <Original permalink not recoverable from the supplied screenshot.>. Reference period: January–July 2019 compared with January–July 2026. Release/date status: Unknown; screenshot received 2026-10-06.. Locator: Full supplied screenshot.

Units and population: Arrivals and paid bednights as claimed; Population and coverage unspecified in the post. Coverage: Claim source only. Revisions: Revision status unknown. Missingness: Both night endpoints and the 2026 arrival endpoint remain unverified.

Archive: sources/uwp-post.png. SHA-256: 6a687421f3d757289b6de4214c37200061751d51ed273c284de5a222dbf58695.

esr2018_t5. Economic and Social Review 2018: Monthly Arrivals by Category. Government of Saint Lucia, Department of Finance, Research and Policy Unit. URL: <https://www.finance.gov.lc/resources/download/2089>. Reference period: 2015–2018. Release/date status: 2019 (exact release date not established). Locator: Appendix Table 5, printed page 92, PDF viewer page 106 (zero-based 105).

Units and population: Stay-over arrival events / person-visits; Nonresident stay-over tourists. Coverage: All twelve monthly stay-over arrival levels in 2015–2018; no imputation. Revisions: 2018 preliminary in this vintage; published annual total matches ESR2025. Missingness: No missing monthly stay-over values in 2015–2018.

Archive: sources/esr2018.pdf. SHA-256: 26c16e31fdf392a19353d1beeeef239ea35c32f81c18b4473ee78f38b8fd124c5.

C2. Policy, accounting and legal records

These records support interpretations and institutional proposals. They are not extra observations in the tourism panel. The Act archive is a checked mirror of the substantive text; commencement evidence includes an archived web retrieval, not an obtained full commencement-order body.

IMF_TA_2025_41. St. Lucia: Technical Assistance Report—Report on External Sector Statistics Mission (October 28–November 1, 2024). International Monetary Fund. <https://www.imf.org/-/media/files/publications/tar/2025/english/tarea2025041-print-pdf.pdf>. Reference: Mission October 28–November 1, 2024; tourism inputs 2018–2023. Date: 2025-01. Locator: Paras. 18–25; printed pp. 8–11; Appendices V–VII; PDF pp. 25–29. Coverage/limits: Survey frames/mode, tourism travel credits and US mirror exercise; Diagnostic mirror scenario is not a universal correction; baseline concepts/sample also differ. Electronic survey representativeness concerns; not a nationally certified corrected series.. Archive sources/policy/imf-ta2025.pdf; SHA-256 0b7c3bf9fb2551560506e04fea18cbd6087830f3c9dbc35df6dc341a21975d3f.

IMF_BPM6. Balance of Payments and International Investment Position Manual, Sixth Edition. International Monetary Fund. <https://data.imf.org/-/media/iData/External-Storage/Documents/73FBCD5B6CDE4D289C60B9B0CAA40622/en/2-bpm6.pdf>. Reference: International methodological framework. Date: 2009. Locator: Paras. 11.33–11.43. Coverage/limits: Primary income and reinvested direct-investment earnings; Framework for published historical statistics; not tourism-specific national income measurement. Archive sources/policy/bpm6.pdf; SHA-256 4731d6cf731f3272169170e9fd1a689dcccdb08db5432b3ccd360bf6ad5973a.

LCA_TDA_2024. Tourism Development Act, No. 1 of 2024. Government of Saint Lucia; National Printing Corporation. <https://npc.govt.lc/files/laws/acts/2024/Act%20No1%20of%202024%20Tourism%20Development%20Act.pdf>. Reference: Act assented 2024-03-06; original enacted text. Date: 2024-03-14. Locator: Part VIII, ss. 146–148, printed pp. 75–77; Part IX, s. 151, printed pp. 78–79; s. 1(2): commencement; ss. 3–5: department functions. Coverage/limits: Database, incentives, information collection and confidentiality; Primary official web text inspected and archived in legal-web-retrieval.json. Original HTTP download returned HTML. Archived substantive PDF supplied via UNCTAD investment-guide mirror; excludes the arrangement of sections. Not certified consolidated law after the June 2026 amendment bill.. Archive sources/policy/tourism-act2024-mirror.pdf; SHA-256 f8781fb5c8ef8600aab8e5e0cdbc527cefeb7e355dbfeb33a4667cb7deaa4604.

LCA_GAZETTE_2024_04_15. Saint Lucia Government Gazette, Issue 16, 15 April 2024. Government of Saint Lucia; National Printing Corporation. https://npc.govt.lc/files/documents/gazettes/2024/4/Gazette_April_15_2024.pdf. Reference: Publication listing for SI 48/2024. Date: 2024-04-15. Locator: Printed p. 517/PDF p. 1: statutory instruments listing. Coverage/limits: The Gazette states that SI 48/2024 is published with and forms part of the issue; Web retrieval archived; the direct file download returned HTML. The full SI 48 body was not recovered, so the exact operative wording could not be read independently.. Archive sources/policy/legal-web-retrieval.json; SHA-256 7e729df5c5d1ae9ce469d23b95bb77de6a815541975ac490f9d5e53bc5596c6e.

LCA_COMMENCEMENT_NOTICE. House of Assembly meets today. Government of Saint Lucia, Ministry of Tourism. <https://tourism.govt.lc/news/house-of-assembly-meets-today14>. Reference: Government legislative notice referring to commencement on 15 April 2024. Date: not stated. Locator: VAT exemption bullet (b)(i). Coverage/limits: Government explicitly references commencement on 15 April 2024 in the VAT amendment description; Corroboration of the commencement date, not a substitute for certified consolidated legislation. Archive sources/policy/legal-web-retrieval.json; SHA-256 7e7

29df5c5d1ae9ce469d23b95bb77de6a815541975ac490f9d5e53bc5596c6e.

LCA_AMENDMENT_BILL_2026. A Sitting of the House of Assembly is scheduled for Tuesday, June 23rd, 2026. Government of Saint Lucia, Ministry of Tourism. <https://tourism.govt.lc/news/a-sitting-of-the-house-of-assembly-is-scheduled-for-tuesday-june-23rd-2026>. Reference: Sitting on 23 June 2026; Senate on 2 July 2026. Date: 2026-06. Locator: Bills list, items 5–6. Coverage/limits: Tourism Development (Amendment) and SLTA (Amendment) bills listed; Listing does not establish passage, assent, commencement or operative changes. The subsequent status remains unresolved in this audit.. Archive sources/policy/june2026-orderpaper.html; SHA-256 5bca2f645b7dc263fb9be8ee4e37d8d35ca9f1cc3af37696e685832cd666ca85.

CSO_PRIVACY. Privacy Notice. Central Statistical Office of Saint Lucia. <https://stats.gov.lc/privacy-notice/>. Reference: Retrieved 6 October 2026. Date: not stated. Locator: Privacy Notice main text. Coverage/limits: Confidentiality obligations under the Statistics Act, Chapter 17.12; The notice supports confidentiality obligations; it is not independent authority for proposed cross-agency microdata linkage or public disclosure. Archive sources/policy/cso-privacy.html; SHA-256 d2a0c08e3143b338ada142d30640b10eb6e31d0c1b476073d3dc829138ff8a2b.

C3. Relevant prior Michel research and epigraph

The cited research papers were inspected in full-text versions, with the relevant sections recorded below. Their conceptual frameworks and distinct datasets do not calibrate the current tourism-income coefficients.

Beyond Chesterton's Fence: Institutional Intervention Readiness in Complex Policy Systems. DOI: <https://doi.org/10.5281/zenodo.21893059>. Version: 1.0, 11 August 2026. Relevant pages: 23–25. Archive sources/policy/iir.pdf; SHA-256 b22c6c4646f77493a0459fce9d54a06664f2c855e4f9461ed89a4f15f67f98d0.

Beyond the First Ripple: RIPPLE-4 as a Mechanism-Based Recursive Policy-Appraisal Framework for Small Open States. DOI: <https://doi.org/10.5281/zenodo.21838896>. Version: Working paper,1.0,7 August2026. Relevant pages: 13–15,43–45. Archive sources/policy/ripple-journal.pdf; SHA-256 ce0bdfd586d662e16ac815165c464f7266de07137c67bd9de2f471a0d97cf38b.

The Inflation That Remained: Sources and Retention of Consumer-Price Increases in Saint Lucia,2019–2025. DOI: <https://doi.org/10.5281/zenodo.21923881>. Version: 1.0,August2026. Relevant pages: 20,23–24. Archive sources/policy/inflation.pdf; SHA-256 e8e1be49ab1db0e0ebffa4378a93794ce1bf6afd4dea550e5308a4bdf630a216.

Incentives by Order: A Census of Published Firm-Specific Tax-Concession Instruments in Saint Lucia,2004–2025. DOI: <https://doi.org/10.5281/zenodo.22094482>. Version: August2026. Relevant pages: 2–3. Archive sources/policy/concessions.pdf; SHA-256 61f0c96aed8f60ca4092af8beffc07323aba399be3f6203bcbd8edbb67fe4af0.

From Output Recovery to Employment Gains: Sectoral Employment Intensity and Uneven Labour-Market Recovery in Saint Lucia,2008–2025. DOI: <https://doi.org/10.5281/zenodo.21908801>. Version: 1.0,11 August2026. Relevant pages: 26–29. Archive sources/policy/employment.pdf; SHA-256 2f2aeda3ae7dbf6d3b3b57d88414f175d3774d2ccdc866ac7161f44f352ad859.

The PITONS Standard: Public Value, Delivery and Learning for Saint Lucia. DOI: <https://doi.org/10.5281/zenodo.22080931>. Version: 1.0,evidence cut-off20 August2026. Relevant pages: 2,4–5,19. Archive sources/policy/pitons.pdf; SHA-256 63e5011d478f32379a9802a89f31e4e00e6a54f9fae9a5a25e9c55475c

9d04b2.

The epigraph was verified in the Book-Access repository at commit d18905ab80a8984d992ba18a5886d03e4730ee22, chapter 5, source line 136. Archive sources/epigraph/michel-where-the-money-sleeps.md; SHA-256 2279f0bc11ae5b83c023c32e15b8c6c16e79d0bbb7ad6f8ff913e7048235b529. It is a research-draft quotation used as normative framing, not empirical evidence.

Appendix D. Literature audit trail

D1. Records and access limits

The audit is targeted, not an exhaustive systematic review. Bibliographic references appear above; the entries below preserve the inspected version and archival status.

IRTS2008: Full text, relevant sections inspected. Locators: Paragraphs 3.25–3.29; 6.31–6.34; 6.48–6.58. Archive sources/literature/irts2008.pdf; SHA-256 91a5c3a34bd78f701389cb6f279c0e7904655450e8d2634b71381c327516711f.

TSA2008: Full text, relevant sections inspected. Locators: Paragraphs 1.15–1.16; 4.88–4.98; Annexes 3–4. Archive sources/literature/tsa2008.pdf; SHA-256 9135519f06b04eb4bd3ec241a304e706f62a0652ebf52f3ea7c83d69530161a0.

SNA2008: Full text, relevant sections inspected. Locators: Paragraphs 2.138–2.146, printed pp.34–35. Archive sources/literature/sna2008.pdf; SHA-256 854883ffc5769747480561c78ba4099ec40257ca8f44d91a85f654b5e715a9b6.

CPI2020: Full text archived; chapter 2 definitions inspected. Locators: Paragraphs 2.29–2.32. Archive sources/literature/cpi2020.pdf; SHA-256 d1fc41eff57f10c228195a0c417a9f14b396eb9dfc69fc0dd57eeddd651c8073.

Mussini2020: Full five-page published article inspected; archived university-hosted copy. Locators: Equations (1)–(5), pp.1–3; conclusion p.4. Archive sources/literature/mussini2020.pdf; SHA-256 30ee aef383b1d80b28f96b8e76e3debba74cae4044b6910bf9d01fd072632fa8.

Shorrocks2013: 2013 published metadata inspected separately; full June 1999 first draft inspected and archived. Locators: June 1999 first draft, general decomposition procedure, Sections 2–3; not the 2013 version of record. Archive sources/literature/shorrocks2013.pdf; SHA-256 931c59b74d68776d18bec08bd244193c1aafc5456ddb89278ce57b64508f166.

Gossling2018: Author-institution abstract and metadata inspected; full article not retrieved. Locators: Abstract. Archive sources/literature/gossling2018-record.html; SHA-256 997730eca402d0d3d7211f1f66fdc97599016048107536d987eea81350e7b52c.

Aguilo2017: Author-institution abstract and metadata inspected; full article not retrieved. Locators: Abstract. Archive sources/literature/agui2017-record.html; SHA-256 48b51a4803eabad033494fea905073868195256bc6876ab44285f507284204ab.

DeCantis2015: Author-institution abstract and metadata inspected; full article not retrieved. Locators: Abstract; author publication record. Archive sources/literature/decantis2015-record.html; SHA-256 1997f287e18be3de512ade08c8d1ccab9ed948c3e00c3ab519448436aaf39323.

Guizzardi2012: Author-institution abstract and metadata inspected; full article not retrieved. Locators: Abstract. Archive sources/literature/guizzardi2012-record.html; SHA-256 78910b4c79ba5e4d9f563eba8977dea5b95dc8120d5da779dc1ea5d532d8718c.

Vergori2025: Full 25-page published article inspected. Locators: Sections 2–3, 5–6 and conclusions. Archive sources/literature/vergori2025.pdf; SHA-256 5e675962eb5d42fd0d8e6fa38594df08bd330d04d2236addc4eeffd7628ad399.

EurostatOccupancy: Official metadata inspected. Locators: Sections 3.1–3.4, 15–17; snapshot retrieved 6 October 2026. Archive sources/literature/eurostat-occupancy.html; SHA-256 47952115a0d9b878c698

50b09c7de9996d33278b1fea7a3a07e1f24bfec2974b.

EurostatPlatforms: Official release inspected. Locators: Opening paragraphs and Background. Archive sources/literature/eurostat-platforms2021.html; SHA-256 5e90dc8ab2259b7ea4f105cf6d36b8eff121623b52794455ab80b04d8a3b08c2.

Manski2005: Publisher abstract inspected through indexed source; full article not retrieved. Locators: Abstract. No original full-text archive was obtained.

Stoye2009: Author-hosted preprint full text inspected; publisher metadata verified. Locators: Introduction, Sections 2–4. Archive sources/literature/stoye2009-pre.pdf; SHA-256 c6b2dc0775223f7867f6254174d83e524c99192ed2c611d3ed20811b814c6407.

ManskiTetenov2016: Full accepted manuscript archived and relevant sections inspected; publisher metadata verified. Locators: Sections 1–3, propositions and decision-theory definitions. Archive sources/literature/manski-tetenov2016.pdf; SHA-256 f3ca6c05db66f777d309e71f9df687d094a10886b58bb2936ae9428523c003b3.

Bertsimas2011: Full published article archived from coauthor page; relevant sections inspected. Locators: Introduction and Sections 2–3. Archive sources/literature/bertsimas2011.pdf; SHA-256 db995ebf97562efee3cc4436a004870720b043e428cab90802ee5f73207b5df4.

OECD2025: Full report inspected. Locators: Printed pp.5–8, 11–12, 28–29. Archive sources/literature/oecd2025-alternative.pdf; SHA-256 d5ba7b1b568c1bcd834566163472550a58cdc0c8fb97d875ab7bca560203cba5.

Duverger2026: Publisher abstract and references inspected; full text restricted. Locators: Abstract. No original full-text archive was obtained.

Pratt2015: Author-institution abstract and metadata inspected; full text restricted. Locators: Abstract. Archive sources/literature/pratt2015-record.html; SHA-256 f1819cd7f53910651fcbb9651d92dcc9f8a a6315cb503b71a543fd42fbdfa093.

D2. Executed search queries

All queries below were executed on 6 October 2026; official and author-institution follow-up sources were preferred. Search-engine result counts are not treated as screening counts.

1. tourism arrivals nights length stay decomposition structural Shapley tourism demand paper
2. tourism partial identification accommodation coverage measurement error bounds tourism recovery
3. International Recommendations Tourism Statistics 2008 overnight visitors nights paid accommodation satellite account resident income
4. "An index decomposition analysis of tourism demand change" authors doi
5. "partial identification" "tourism"
6. "tourism" "bounds" "measurement error" statistics
7. "Accommodation statistics: the current issues and an innovation"
8. Manski partial identification missing data bounds sample selection 1990 nonparametric bounds treatment effects pdf
9. Stoye minimax regret treatment choice finite samples 2009 pdf
10. Manski Tetenov sufficient trial size inform clinical practice 2016 sample size decision pdf

11. Eurostat collaborative economy platforms accommodation statistics methodological notes coverage overlaps nights 2025
12. "Partial identification with missing data" Manski 2005 pdf
13. site.unstats.un.org "Tourism Satellite Account" "direct" "indirect"
14. site.imf.org "Saint Lucia" "tourism" "14 percent" survey 2024
15. site.worldbank.org tourism small states statistics capacity visitor expenditure survey
16. "Unobserved tourism" "2015" "De Cantis" pdf
17. "Length of stay and daily tourist expenditure" "2017" doi
18. "price" "real income" "System of National Accounts" "gross national income"
19. "tourism" "partial identification" "bounds" -scribd -identification?"
20. "tourism" "value of information" measurement survey design
21. "Precise tourist spending estimates under budget constraints" pdf
22. site.unstats.un.org sna2008 pdf gross national income primary income nonresident enterprises resident
23. site.imf.org consumer price index manual 2020 household consumption deflator real income pdf
24. "tourism" "small states" "statistical capacity" "PARIS21"
25. "Manski" "2005" "Partial identification with missing data" filetype:pdf
26. Shorrocks 2013 decomposition procedures distributional analysis unified framework Shapley value DOI pdf
27. Bertsimas Brown Caramanis 2011 theory applications robust optimization SIAM review pdf
28. "small island" "tourism" "statistical" "survey" "cost" site.oecd.org
29. "The economic impact of tourism in SIDS" "Pratt" doi
30. "tourism" "partial identification" -scribd -researchgate -books.apple.com -books.google.com -play.google.com
31. "tourism" "recovery" "identification bounds"
32. "tourism" "measurement" "decision" "minimax"
33. "Sufficient trial size" pdf Manski Tetenov site.tetenov.com
34. "Partial identification with missing data" "manski" "pdf" -researchgate -sciencedirect -researchr -dialnet -eurekamag

Appendix E. Reproducible analysis code

The scripts below are the executed numerical analysis. Run `python3 empirical_analysis.py`, then `python3 methods_analysis.py`, then `python3 make_figures.py` from the project directory. Inputs are in `data/`; outputs are JSON result files and the eight figures. Python, NumPy, SciPy and Matplotlib are required. No network, credentials or private records are needed to rerun the final analysis.

The PDF embedded ZIP supplies the exact CSV column names and unrounded inputs. Appendix A contains every numerical observation needed for the reported core comparisons and charts. Source/status columns in the CSVs preserve metadata but do not change arithmetic. The longer market table includes earlier years not used by the script; only the three reported years enter the analysis. The source extraction script and manifest are also included in the companion record, but extraction from raw web files is not required to rerun these final calculations.

Executed environment: Python 3.12.14; NumPy 2.3.5; SciPy 1.17.0; Matplotlib 3.10.8.

empirical_analysis.py

```

"""Reproduce descriptive results. No imputation or causal estimation.
Inputs: archived-source transcriptions in data/. Outputs: empirical_results.json.
Paid nights are rounded millions; CPI deflation is a diagnostic, not tourism GDP.
"""

import csv
import json
import itertools
from pathlib import Path

HERE = Path(__file__).resolve().parent
def read(name):
    with (HERE/'data'/name).open(newline='') as f:
        return list(csv.DictReader(f))
def pct(a,b):
    return (a/b-1)*100
def shapley(a0,a1,o0,o1):
    j0,j1=o0/a0,o1/a1
    pa=(a1-a0)*(j0+j1)/2
    pj=(j1-j0)*(a0+a1)/2
    assert abs(pa+pj-(o1-o0))<1e-6
    return dict(arrival_contribution=pa,intensity_contribution=pj,
                total_change=o1-o0,intensity0=j0,intensity1=j1)

def main():
    annual={int(r['year']):r for r in read('annual.csv')}
    long={int(r['year']):r for r in read('annual_2011_2025.csv')}
    monthly=read('monthly.csv')
    cpi_rows=read('cpi_monthly_revised.csv')
    for year,row in annual.items():
        observations=[float(r['all_items_cpi']) for r in cpi_rows if int(r['year'])==year]
        assert len(observations)==12
        assert abs(sum(observations)/12-float(row['annual_cpi']))<1e-9
    keys=['stayover_arrivals','paid_bednights_millions_rounded',
          'stayover_expenditure_ec_millions','real_accommodation_food_gva_ec_millions_2018',
          'real_accommodation_gva_ec_millions_2018','real_food_services_gva_ec_millions_2018',
          'annual_cpi']
    comparisons=[]
    for y0,y1 in [(2019,2025),(2024,2025),(2019,2024)]:
        r0,r1=annual[y0],annual[y1]
        d=dict(baseline=y0,latest=y1)
        d['percent_changes']={k:pct(float(r1[k]),float(r0[k])) for k in keys}
        a0,a1=(int(r['stayover_arrivals']) for r in (r0,r1))
        o0,o1=(float(r['paid_bednights_millions_rounded'])*1e6 for r in (r0,r1))
        d['shapley']=shapley(a0,a1,o0,o1)
        d['paid_night_ratio']=o1/o0
        d['nominal_yield_break_even_increase_percent']=pct(o0,o1)
        d['same_coverage_same_conversion_cpi_adjusted_yield_break_even_increase_percent']=((o0/o1)*(float(r1['annual_cpi'])/float(r0[
        ↵ 'annual_cpi']))-1)*100

```

```

d['cpi_deflated_reported_expenditure_change_percent']=pct(
    float(r1['stayover_expenditure_ec_millions'])/float(r1['annual_cpi']),
    float(r0['stayover_expenditure_ec_millions'])/float(r0['annual_cpi']))
vals=[shapley(a0,a1,o0+e0,o1+e1) for e0,e1 in itertools.product([-5000,5000],repeat=2)]
d['conventional_rounding_shapley_ranges']={k:[min(v[k] for v in vals),max(v[k] for v in vals)] for k in
↪ ['arrival_contribution','intensity_contribution','total_change']}
d['conventional_rounding_night_growth_percent_bounds']=[pct(o1-5000,o0+5000),pct(o1+5000,o0-5000)]
comparisons.append(d)
totals=[]
seasonal=[]
baseline={int(r['month']):int(r['stayover_arrivals']) for r in monthly if int(r['year'])==2019}
for y in range(2015,2026):
    rows=[r for r in monthly if int(r['year'])==y]
    assert sorted(int(r['month']) for r in rows)==list(range(1,13))
    total=sum(int(r['stayover_arrivals']) for r in rows)
    stated=int(long[y]['stayover_arrivals'])
    jan_jul=sum(int(r['stayover_arrivals']) for r in rows if int(r['month'])<=7)
    totals.append(dict(year=y,monthly_sum=total,published_annual=stated,
        difference=total-stated,jan_jul=jan_jul))

    for r in rows:
        m=int(r['month']); a=int(r['stayover_arrivals'])
        seasonal.append(dict(year=y,month=m,arrivals=a,index_same_month_2019=100*a/baseline[m]))
market_rows=read('markets.csv')
market_results=[]
for y in (2019,2024,2025):
    rows=[r for r in market_rows if int(r['year'])==y]
    total=sum(int(r['arrivals']) for r in rows)
    assert total==int(annual[y]['stayover_arrivals'])
    market_results += [dict(year=y,market=r['market'],arrivals=int(r['arrivals']),share_percent=int(r['arrivals'])/total*100) for r in
↪ rows]

# These are calculations of claims, not authenticated 2026 observations.
claim=dict(arrivals2019=262381,arrivals2026=268842,nights2019=1718900,nights2026=1588628)
claim['arrival_change_percent']=pct(claim['arrivals2026'],claim['arrivals2019'])
claim['night_change_percent']=pct(claim['nights2026'],claim['nights2019'])
claim['nominal_yield_break_even_percent']=pct(claim['nights2019'],claim['nights2026'])
byyear={r['year']:r for r in totals}
claim['arrivals_vs2024_percent']=pct(claim['arrivals2026'],byyear[2024]['jan_jul'])
claim['arrivals_vs2025_percent']=pct(claim['arrivals2026'],byyear[2025]['jan_jul'])
result=dict(comparisons=comparisons,monthly_reconciliation=totals,monthly_indices=seasonal,
    market_shares=market_results,conditional_claim_arithmetic=claim,
    analysis_note='Observational, mixed monthly source vintages explicitly retained. Synthetic experiments are separate.')
(HERE/'data/'/'empirical_results.json').write_text(json.dumps(result,indent=2)+'\n')
print(json.dumps({k:result[k] for k in ['comparisons','monthly_reconciliation','market_shares']},indent=2))

if __name__=='__main__':
    main()

```

methods_analysis.py

```

"""Reproduce the paper's illustrative methods experiments (not national estimates).
Python 3; numpy and scipy. Fixed seed; writes methods_results.json.
All uncertainty ranges, action costs and attainable widths here are hypothetical.
"""

```

```

import itertools
import json
from pathlib import Path
import numpy as np
from scipy.optimize import linprog

HERE = Path(__file__).resolve().parent
SEED = 23197449
rng = np.random.default_rng(SEED)

def bounds(q, intervals):
    lower = upper = q
    for lo, hi, exponent in intervals:
        lower *= lo if exponent == 1 else 1 / hi
        upper *= hi if exponent == 1 else 1 / lo
    return [lower, upper]

def main():

```

```

# A constructive pair of feasible economies with identical published A,0.
A0, A1, O0, O1 = 100000, 110000, 1000000, 900000
y, v, r, P0, P1, c = 100, .6, .8, 1, 1.1, .8
g0 = O0*y*v*r/P0
worlds = []
for k1 in (1., .75):
    b1 = O1/k1
    g1 = b1*y*v*r/P1
    worlds.append(dict(k1=k1, A0=A0, A1=A1, O0=O0, O1=O1,
        B0=O0, B1=b1, c=c, L0=O0/(A0*c), L1=b1/(A1*c),
        y=y, v=v, r=r, P0=P0, P1=P1,
        G0=g0, G1=g1, growth_percent=100*(g1/g0-1)))

# Published rounded annual nights; q is an empirical anchor only.
q = 2.41/2.79
raw = [(0.85, 1.05, -1), (1.0, 1.45, 1),
        (.85, 1.10, 1), (.90, 1.10, 1), (1.10, 1.30, -1)]
names = ['coverage k1/k0', 'yield y1/y0', 'GVA coefficient v1/v0',
        'resident share r1/r0', 'price index P1/P0']
box = bounds(q, raw)
corners = []
for pick in itertools.product((0,1), repeat=len(raw)):
    value = q
    for j, (lo,hi,e) in enumerate(raw):
        value *= (lo if pick[j]==0 else hi)**e
    corners.append(value)
assert np.allclose([min(corners), max(corners)], box)
# Log-linear program reproduces unconstrained box; it can add joint facts.
objective = np.array([z[2] for z in raw])
log_bounds = [(np.log(lo), np.log(hi)) for lo,hi,_ in raw]
lp_lo = linprog(objective, bounds=log_bounds, method='highs')
lp_hi = linprog(-objective, bounds=log_bounds, method='highs')
assert lp_lo.success and lp_hi.success
assert np.allclose(box, [q*np.exp(lp_lo.fun), q*np.exp(-lp_hi.fun)])
# Known compatible E1/E0=1.10 creates -log(k ratio)+log(y ratio)=log(1.10/q).
row = np.array([-1., 1., 0., 0., 0.])
rhs = np.array([np.log(1.10/q)])
c_lo = linprog(objective, A_eq=row, b_eq=rhs, bounds=log_bounds, method='highs')
c_hi = linprog(-objective, A_eq=row, b_eq=rhs, bounds=log_bounds, method='highs')
assert c_lo.success and c_hi.success
coupled = [q*np.exp(c_lo.fun), q*np.exp(-c_hi.fun)]
substituted = bounds(1.10, raw[2:])
assert np.allclose(coupled, substituted)

# Known propensities are an oracle illustration, not feasible survey weights.
# Completed responses from a population: half spend100, half spend300.
simulations = []
reps = 20000
for n in (200,800):
    for p_low, p_high in ((.8,.2), (.2,.8)):
        ph = p_high/(p_low+p_high)
        h = rng.binomial(n, ph, size=reps)
        naive = (100*(n-h)+300*h)/n
        hajek = (100*(n-h)/p_low+300*h/p_high)/((n-h)/p_low+h/p_high)
        for estimator, estimates in [('respondent mean', naive), ('oracle IPW Hajek', hajek)]:
            simulations.append(dict(n=n, repetitions=reps, p_low=p_low, p_high=p_high,
                estimator=estimator, population_mean=200,
                theoretical_respondent_mean=100*(1-ph)+300*ph,
                mean=float(np.mean(estimates)), bias=float(np.mean(estimates)-200),
                rmse=float(np.sqrt(np.mean((estimates-200)**2))),
                monte_carlo_se_of_mean=float(np.std(estimates, ddof=1)/np.sqrt(reps))))

# Finite measurement design: no guarantee about where future intervals centre.
# Action0=no new observation; actions1,2 reduce full log widths to40%,5%.
widths = np.array([np.log(hi/lo) for lo,hi,_ in raw])
fractions = np.array([1., .4, .05])
days = [[0,4,9], [0,6,13], [0,10,22], [0,8,18], [0,2,4]]
schedules = []
for actions in itertools.product(range(3), repeat=5):
    cost = sum(days[j][a] for j,a in enumerate(actions))
    width = float(sum(widths[j]*fractions[a] for j,a in enumerate(actions)))
    schedules.append(dict(actions=list(actions), person_days=cost, log_width=width,
        upper_lower_ratio=float(np.exp(width))))

```

```

frontier = []
for budget in range(67):
    best = min((s for s in schedules if s['person_days'] <= budget),
               key=lambda s: (s['log_width'], s['person_days'], s['actions']))
    frontier.append(dict(budget=budget, **best))
targets = []
for margin in (.05, .10, .20):
    delta = np.log(1+margin)
    feasible = [s for s in schedules if s['log_width'] < delta]
    best = min(feasible, key=lambda s: (s['log_width'], s['actions'])) if feasible else None
    targets.append(dict(assumed_ratio_margin=margin, log_margin=float(delta), least_cost=best))

# Full-tourism ambiguity and signed cost example, arbitrary currency units.
additive = dict(G0=100, G1=90, U0=20, U1_lower=10, U1_upper=50)
additive['total_ratio_bounds'] = [100/120, 140/120]
cost_example = dict(G0=100, G1_bounds=[90, 120], C0=10, C1_bounds=[5, 30],
                    N0=90, N1_bounds=[60, 115], net_ratio_bounds=[60/90, 115/90])
out = dict(seed=SEED, worlds=worlds, anchor_paid_night_ratio=q,
           anchor_rounding_assumption_ratio_bounds=[2.405/2.795, 2.415/2.785],
           factor_names=names, factor_intervals=raw, box_ratio_bounds=box,
           lp_box_ratio_bounds=[q*np.exp(lp_lo.fun), q*np.exp(-lp_hi.fun)],
           compatible_receipts_ratio_assumption=1.10, coupled_ratio_bounds=coupled,
           receipt_substitution_ratio_bounds=substituted, survey_simulation=simulations,
           measurement_base_log_widths=widths.tolist(), measurement_action_fractions=fractions.tolist(),
           measurement_cost_person_days=days, measurement_schedules_evaluated=len(schedules),
           measurement_frontier=frontier, measurement_targets=targets,
           all_tourism_additive_example=additive, signed_cost_example=cost_example)
(HERE/'data/'/'methods_results.json').write_text(json.dumps(out, indent=2)+'\n')
print(json.dumps({k: out[k] for k in ['worlds', 'box_ratio_bounds', 'coupled_ratio_bounds',
                                     'survey_simulation', 'measurement_targets']}, indent=2))

if __name__ == '__main__':
    main()

```

make_figures.py

```

"""Render publication figures from executed results; matplotlib only."""
import csv, json
from pathlib import Path
import numpy as np
import matplotlib
matplotlib.use('Agg')
import matplotlib.pyplot as plt
from matplotlib.colors import TwoSlopeNorm
ROOT = Path(__file__).resolve().parent
F = ROOT/'figures'; F.mkdir(exist_ok=True)
E = json.loads((ROOT/'data/empirical_results.json').read_text())
M = json.loads((ROOT/'data/methods_results.json').read_text())
with (ROOT/'data/annual_2011_2025.csv').open() as f: annual = list(csv.DictReader(f))
navy, teal, gold, red, grey = '#143447', '#007E87', '#C18B15', '#B54E59', '#58717B'
plt.rcParams.update({'font.family': 'DejaVu Sans', 'font.size': 10, 'axes.labelcolor': navy,
                    'text.color': navy, 'xtick.color': grey, 'ytick.color': grey, 'axes.edgecolor': '#B9C7CE',
                    'axes.spines.top': False, 'axes.spines.right': False, 'figure.facecolor': 'white',
                    'axes.facecolor': 'white', 'savefig.facecolor': 'white', 'axes.titleweight': 'bold',
                    'axes.titlesize': 12, 'pdf.fonttype': 42})
def save(fig, name):
    fig.savefig(F/(name+'.png'), dpi=300, bbox_inches='tight'); fig.savefig(F/(name+'.pdf'), bbox_inches='tight'); plt.close(fig)

# Figure1: common-vintage annual series; zero axis prevents exaggerated gap.
years = [int(r['year']) for r in annual]
a = np.array([int(r['stayover_arrivals']) for r in annual])/423736*100
b = np.array([float(r['paid_bednights_millions_rounded']) for r in annual])/2.79*100
fig, ax = plt.subplots(figsize=(7.2, 3.5)); ax.axvspan(2020, 2021, color='#E8EDF0')
ax.plot(years, a, 'o-', color=teal, lw=2, label='Stay-over arrivals', ms=4)
ax.plot(years, b, 's-', color=gold, lw=2, label='Published paid nights', ms=4)
ax.axhline(100, color=grey, lw=.8, ls=':'); ax.set_ylim(0, 115); ax.set_xlim(2010.6, 2026.3)
ax.set_xticks([2011, 2013, 2015, 2017, 2019, 2021, 2023, 2025]); ax.set_ylabel('Index, 2019 = 100')
ax.text(2025.15, a[-1], f'{a[-1]:.1f}', color=teal, va='center', weight='bold')
ax.text(2025.15, b[-1], f'{b[-1]:.1f}', color=gold, va='center', weight='bold')
ax.legend(frameon=False, loc='lower left'); ax.grid(axis='y', alpha=.2); save(fig, '01-recovery')

```

```

# Figure2: reconciled monthly series; alternative vintages retained in audit.
matrix=np.array([[r['index_same_month_2019'] for r in E['monthly_indices'] if r['year']==y] for y in range(2015,2026)])
fig,ax=plt.subplots(figsize=(7.2,4.3));
    im=ax.imshow(matrix,cmap='BrBG',norm=TwoSlopeNorm(vmin=0,vcenter=100,vmax=max(145,float(matrix.max()))),aspect='auto')
ax.set_xticks(range(12),['Jan','Feb','Mar','Apr','May','Jun','Jul','Aug','Sep','Oct','Nov','Dec'])
ax.set_yticks(range(11),[str(y) for y in range(2015,2026)])
for i in range(11):
    for j in range(12):
        val=matrix[i,j];ax.text(j,i,f'{val:.0f}',ha='center',va='center',fontsize=8,color='white' if val<43 or val>135 else navy)
fig.colorbar(im,ax=ax,shrink=.8,label='Arrivals / same month in 2019 × 100');save(fig,'02-monthly')

# Figure3: series differ in scope; never label these all tourism GVA.
d=E['comparisons'][0]
vals=[d['percent_changes'][d['stayover_arrivals'],d['percent_changes'][d['paid_bednights_millions_rounded'],d['percent_changes'][d[
    'real_accommodation_food_gva_ec_millions_2018'],d['percent_changes'][d['stayover_expenditure_ec_millions'],d[
    'cpi_deflated_reported_expenditure_change_percent']]
labs=['Stay-over arrivals','Published paid nights','Accommodation + food: real GVA','Reported stay-over expenditure*','Reported expenditure /
    annual CPI*']
fig,ax=plt.subplots(figsize=(7.2,3.3)); bars=ax.barh(range(5),vals,color=[teal,gold,teal,grey,grey],height=.58)
for i in [3,4]:bars[i].set_hatch('///');bars[i].set_edgecolor('white')
ax.set_yticks(range(5),labs,fontsize=9);ax.invert_yaxis();ax.axvline(0,color=navy,lw=.8);ax.set_xlim(-20,40)
for i,vv in enumerate(vals):ax.text(vv+1 if vv>=0 else vv-2,i,f'{vv:+.1f}%',va='center',ha='left' if vv>=0 else
    'center',weight='bold',color=navy if vv>=0 else 'white')
ax.set_xlabel('Change, 2019 to 2025 (%)');ax.grid(axis='x',alpha=.15);save(fig,'03-different-outcomes')

# Figure4: exact twofactor allocation, rounded source nights.
fig,axes=plt.subplots(1,2,figsize=(7.2,3.1),sharey=True)
for ax,d in zip(axes,E['comparisons'][2:]):
    s=d['shapley'];values=np.array([s['arrival_contribution'],s['intensity_contribution'],s['total_change']])/1000
    ax.bar(range(3),values,color=[teal,gold,navy],width=.65);ax.axhline(0,color=grey,lw=.8)
    for i,vv in enumerate(values):ax.text(i,vv+12 if vv>=0 else vv-12,f'{vv:+.0f}',ha='center',va='bottom' if vv>=0 else 'top',weight='bold')
    ax.set_xticks(range(3),['Arrivals','Night intensity','Net change'],fontsize=8);ax.set_title(f'{d["baseline"]} to
        {d["latest"]}');ax.set_ylim(-460,65);ax.grid(axis='y',alpha=.15)
axes[0].set_ylabel('Contribution, thousand published paid nights');fig.tight_layout();save(fig,'04-decomposition')

# Figure5: identical arrivals and observed nights, opposite income outcomes.
fig,ax=plt.subplots(figsize=(7.2,3.1)); ys=[0,1]
changes=[w['growth_percent'] for w in M['worlds']]
ax.barh(ys,changes,color=[red,teal],height=.5);ax.axvline(0,color=navy,lw=.8)
ax.set_yticks(ys,['World A: full capture in both periods','World B: capture falls to 75%']);ax.invert_yaxis();ax.set_xlim(-25,15)
for i,val in enumerate(changes):ax.text(val+.7 if val>=0 else -.7,i,f'{val:+.1f}%',ha='left' if val>=0 else
    'right',va='center',weight='bold')
ax.set_xlabel('Change in constructed real resident factor income (%)');ax.text(.5,1.1,'Both worlds: arrivals +10%; published paid nights
    -10%',transform=ax.transAxes,ha='center',weight='bold');save(fig,'05-two-worlds')

# Figure6: conditional threshold, not a country confidence region.
k=np.linspace(.80,1.10,160);h=np.linspace(.80,1.60,160);K,H=np.meshgrid(k,h)
ratio=M['anchor_paid_night_ratio']*H/K
fig,ax=plt.subplots(figsize=(7.2,3.9));
    im=ax.pcolormesh(K,H,100*(ratio-1),cmap='BrBG',norm=TwoSlopeNorm(vmin=-40,vcenter=0,vmax=80),shading='auto')
ax.contour(K,H,ratio,levels=[1],colors=[navy],linewidths=[2]);ax.plot(k,k/M['anchor_paid_night_ratio'],color=navy,lw=2)
ax.axvline(1,color=navy,lw=.8,ls=':');ax.plot(1,1/M['anchor_paid_night_ratio'],'o',color=navy,ms=5)
ax.text(.815,1.51,'Growth region',color=navy,weight='bold');ax.text(.935,.87,'Decline region',color=navy,weight='bold')
ax.set_xlabel('Coverage / measurement-factor ratio K');ax.set_ylabel('Real resident income per true paid night, YVR/Q')
fig.colorbar(im,ax=ax,label='Constructed income change (%)');save(fig,'06-threshold')

# Figure7: selection error persists when completed-response count grows.
fig,axes=plt.subplots(1,2,figsize=(7.2,3.0),sharey=True)
for ax,n in zip(axes,[200,800]):
    rows=[r for r in M['survey_simulation'] if r['n']==n and r['p_low']==.8]
    ax.bar([0,1],[r['mean'] for r in rows],color=[red,teal],width=.55)
    ax.axhline(200,color=navy,lw=1,ls='--');ax.set_ylim(0,235);ax.set_xticks([0,1],['Unweighted','Oracle IPW'],fontsize=9);ax.set_title(f'{n}
        completed responses')
    for i,r in enumerate(rows):ax.text(i,r['mean']+5,f'{r["mean"]:.1f}',ha='center',weight='bold')
    ax.grid(axis='y',alpha=.15)
axes[0].set_ylabel('Mean estimated spend (synthetic units)');fig.tight_layout();save(fig,'07-selection')

# Figure8: precision frontier cannot promise sign before observations arrive.
fig,ax=plt.subplots(figsize=(7.2,3.5)); front=M['measurement_frontier'];x=[r['budget'] for r in front];w=[r['log_width'] for r in front]
ax.step(x,w,where='post',color=teal,lw=2);ax.fill_between(x,w,step='post',color=teal,alpha=.08)
for margin,col,ls in [(.20,gold,'--'),(.10,navy,':'),(.05,red,'-.')]:
    ax.axhline(np.log(1+margin),color=col,ls=ls,lw=1,label=f'log(1+margin:.2f) separation target')
ax.set_xlim(0,68);ax.set_ylim(0,1.27);ax.set_xlabel('Hypothetical collection budget (person-days)');ax.set_ylabel('Smallest guaranteed full
    log-interval width')

```

```
ax.legend(frameon=False, fontsize=8, loc='upper right'); ax.grid(axis='y', alpha=.15); save(fig, '08-measurement')
print('Eight figure pairs written to figures/.')
```