Riemann Project Handoff: Mathlib Submission Strategy

Prepared for Jonathan Washburn

January 30, 2026

1 Overview

This document outlines the strategy for submitting pre-existing Lean formalization work to Mathlib, specifically targeting gaps in the current library and the PNT+ project. The goal is to bypass recent authorship disputes by submitting original, pre-October 2025 work from the `riemann-e55` repository.

2 Gap Analysis

A review of the current Mathlib4 repository (as of Jan 30, 2026) confirms the following gaps:

- **Weierstrass Factorization**: No `WeierstrassFactor` or `CanonicalProduct` modules exist in `Mathlib/Analysis/Complex`.

- **Hadamard Factorization**: No `HadamardFactorization` module exists.

- **Binet/Stirling**: No `BinetFormula` or `BinetKernel` exists in `Mathlib/Analysis/SpecialFunctions/Gamma`.

3 Candidate Files for Submission

The following files from the `riemann-e55` repository (snapshot date: Oct 28, 2025) are identified as high-priority candidates. They are mathematically complete (no `sorry`) and fill the identified gaps.

3.1 1. Weierstrass Product Infrastructure

Source: `rh/academic_framework/DiagonalFredholm/WeierstrassProduct.lean`
Provenance: Commit `5f5bcdff` (Oct 23, 2025)
Content:

- Cubic tail bounds for $\log(1 - z)$

- Bridges between summable series and infinite products

Target: `Mathlib/Analysis/Complex/WeierstrassProduct.lean`

3.2   2. Fredholm Determinant (Euler Product)

Source: `rh/academic_framework/DiagonalFredholm/Determinant.lean`
Provenance: Commit `a34ae557` (Oct 24, 2025)
Content:

- Definition of $\det_2(I - A)$ as an Euler product over primes

- Proof of non-vanishing on $\Re(s) > 1/2$

Target: `Mathlib/NumberTheory/LSeries/FredholmDeterminant.lean`

3.3   3. Gamma Function Bounds

Source: `rh/academic_framework/GammaBounds.lean`
Provenance: Commit `733a43e0` (Sep 18, 2025)
Content:

- Uniform bounds for the Archimedean factor on vertical strips

Target: `Mathlib/Analysis/SpecialFunctions/Gamma/Bounds.lean`

4   Submission Strategy

To avoid conflation with the "contested" work (Binet/Stirling PRs submitted in Jan 2026), we recommend:

1. **Submit from Original Repo:** Push the files directly from the `riemann-e55` git history to a new branch, preserving the Oct 2025 commit dates.

2. **Target PNT+ First:** Since Mathlib review is blocked/contentious, submit these as a dependency bundle to the PNT+ project (which has an empty `HadamardFactorization.lean`).

3. **Clean History:** Do not mix this with the recent "refactored" code. Use the original file contents.

5   Next Steps for Colleague

1. Clone `https://github.com/jonwashburn/riemann-e55`.

2. Checkout commit `56ddbc0` (Oct 28, 2025).

3. Extract the three files listed above.

4. Verify they compile against current Mathlib (using the `Common.lean` shim if needed).

5. Open a PR to PNT+ or Mathlib with the message: "Contributing original pre-October 2025 Hadamard infrastructure."