

Solutions

2.1

- $q = \sqrt{1/10\,000} = 1/100$; carriers $2pq \approx 1/50$ ✓.

2.2

- $q \approx 1/60$ ($2pq \approx 1/30 \rightarrow q \approx 1/60$).

2.3

- Heterozygote advantage against malaria (selection).

3.1

- Residual = $(1/25 \times 0.05) / (1/25 \times 0.05 + 24/25 \times 1) \approx 0.002 \approx 1/500$ ✓ (Bayes).
- Child risk = $1 \times 1/500 \times 1/4 = 1/2000$ ✓.
- Not zero: no panel detects every variant (CNVs, regulatory, rare missense).

3.2

- $q = \sqrt{1/40\,000} = 1/200$; carriers $\approx 1/100$ ✓.
- Two carriers meeting: $(1/100)^2 = 1/10\,000$; with the $1/4$ affected-child factor that IS the $1/40\,000$ disease rate ✓.
- A founder effect concentrates the allele in a subgroup: carriers $1/30 \rightarrow q^2$ -based expectations rise orders of magnitude.