

# FractaLPK — Tumor Auto-Diagnose Report

Dataset: **tumor\_hahnfeldt\_fractional** · Generated: 2026-05-07 20:14 UTC · ID: c203191079

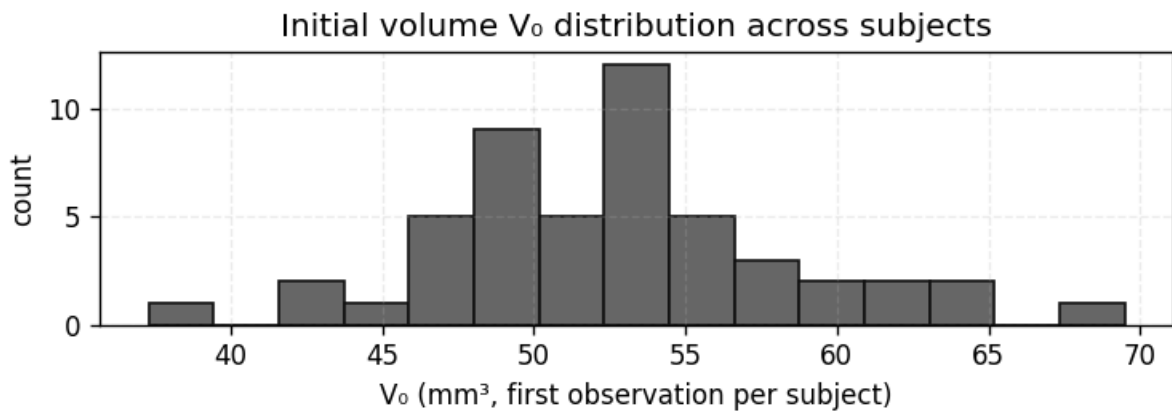
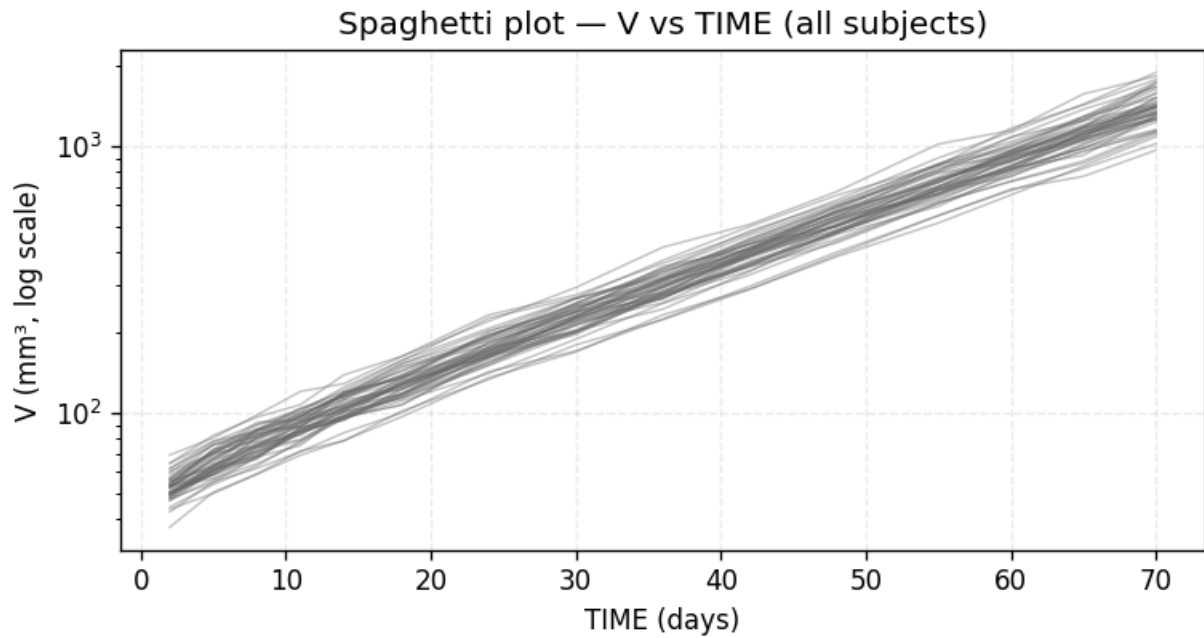
Rule applied	RULE 3 FRACTIONAL HAHNFELDT
Selected model	Hahnfeldt fractional ( $R^2 = 1.000$ , $AIC = -132.94$ )
$\Delta AIC$ vs runner-up	34.19
Confidence	high
Verdict	FRACTIONAL HAHNFELDT DYNAMICS — Best model: [Hahnfeldt fractional] with $\alpha = 0.5$

## Key parameters

Parameter	Estimate
v0	53.07
d	0.3121
alpha	0.5726

## Dataset overview

Subjects (N)	50
Observations	750
TIME range (days)	2.0 - 70.0
V range (mm <sup>3</sup> )	37.3 - 1884.1



## Model comparison — 5 structural variants

#	Model	Class	n	OFV	AIC	$\Delta$ AIC	R <sup>2</sup>	Conv
1 ★	Hahnfeldt fractional	hahnfeldt_fractional	3	-138.94	-132.94	ref	1.000	✓
2	Gompertz	gompertz	3	-104.76	-98.76	+34.19	1.000	✓
3	Logistic	logistic	3	-94.94	-88.94	+44.00	0.999	✓
4	Exponential	exponential	2	-81.87	-77.87	+55.07	0.999	✓
5	Hahnfeldt classical	hahnfeldt_classical	2	-70.83	-66.83	+66.11	0.997	✓

## Verdict — rule applied

Rule 3 — Hahnfeldt fractional wins by  $\Delta AIC \geq 4$  (or  $\geq 8$  in short exponential-only windows). Sub-unit  $\alpha$  captures memory effects in the tumor-vasculature coupling.

## Selected model — parameter estimates

Hahnfeldt fractional · hahnfeldt\_fractional · 3 free parameters

### THETA — population estimates

Parameter	Estimate	%RSE
v0	53.07	N/A
d	0.3121	N/A
alpha	0.5726	N/A
lambda (fixed)	0.192	—
b (fixed)	5.85	—

### Assumption

Assumption:  $K_{\text{initial}}$  (initial vasculature carrying capacity) is set equal to  $V_{\text{initial}}$  at the start of follow-up. The dataset reports tumor volume only; vasculature is not directly measured. This is the standard Hahnfeldt 1999 convention. The estimated dynamics of  $K(t)$  are model-derived, not observed.

## Selected model — variability & residual error

### OMEGA — between-subject variability

Per-subject NLME (FOCEI / SAEM) is in development for a later phase. The current report uses a population-mean fit; OMEGA matrix and shrinkage cannot be computed from this single fit. Reporting placeholders below.

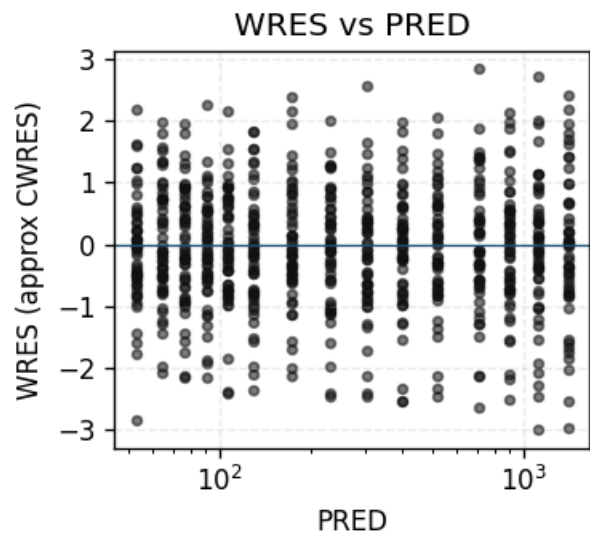
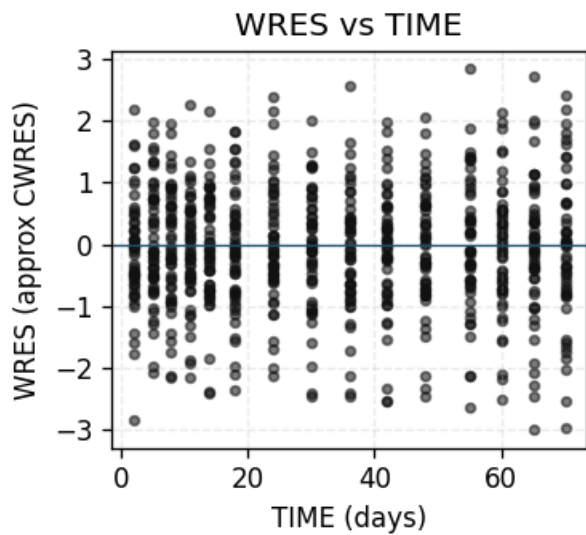
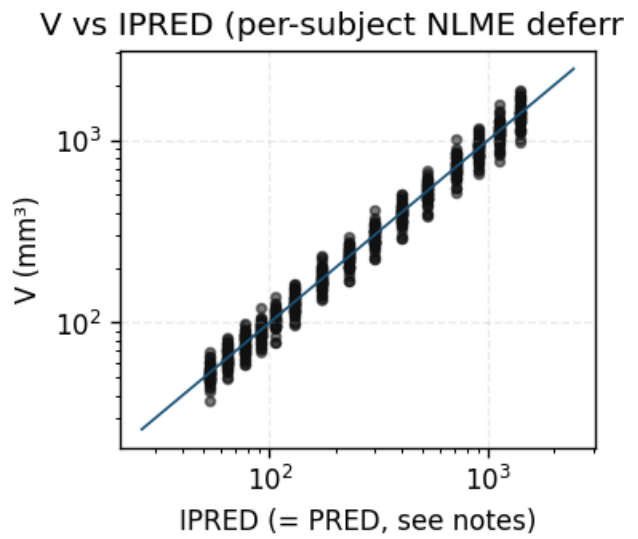
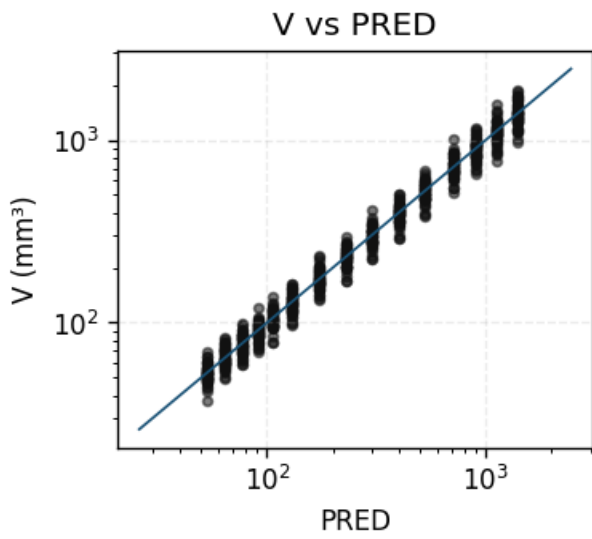
Parameter	OMEGA (variance)	Shrinkage (%)
IIV (v■)	—	—
IIV (d)	—	—
IIV ( $\alpha$ )	—	—

### Fractional kinetics — interpretation

$\alpha = 0.573$  (synthetic validation accuracy  $\pm 0.10$ ; reported 95% range [0.473, 0.673]).

Fractional order  $\alpha$  is estimated from the data with synthetic validation accuracy  $\pm 0.10$ ; clinical/biological interpretation of  $\alpha$  is the responsibility of the user's expert team.

# Goodness-of-fit

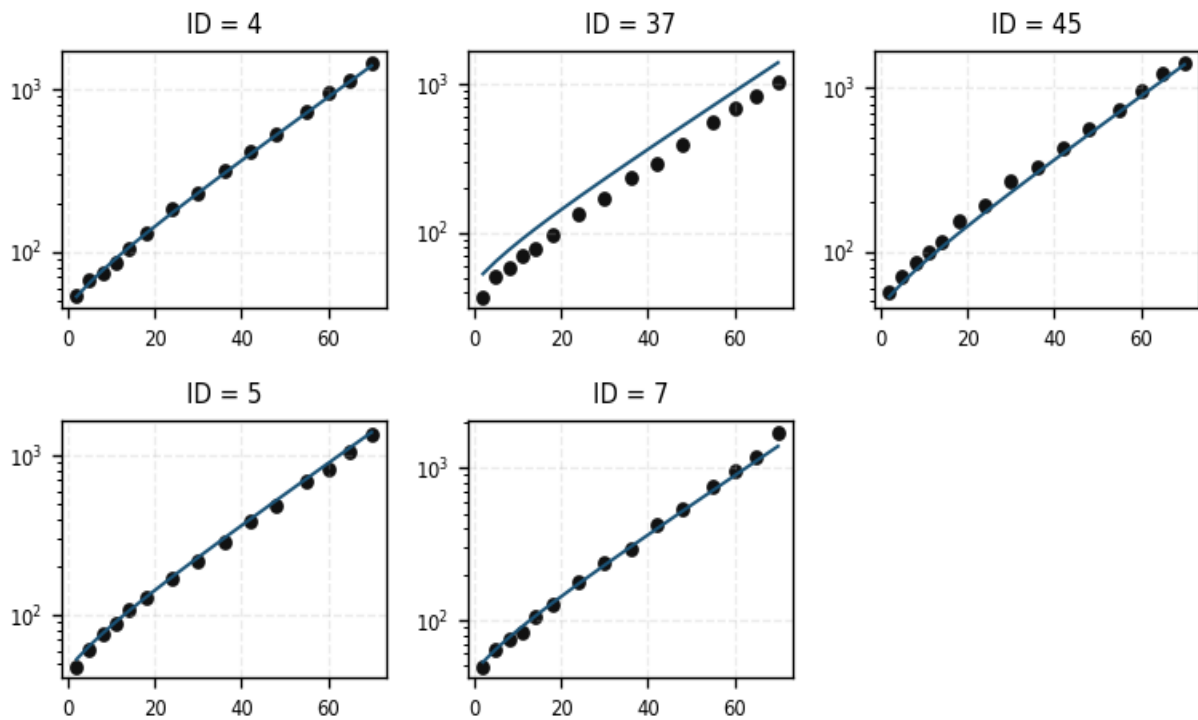


WRES is shown as a proxy for CWRES; conditional weighted residuals from FOCEI are scheduled for a later phase. IPRED equals PRED because the engine fits the population mean curve only.

# Individual fits

Representative subjects (best-fit, worst-fit, median, plus spread): 4, 37, 45, 5, 7

Individual fits (representative subjects)



# Diagnostics & methodological notes

Metric	Value
Winner iterations	559
Winner wall time (s)	807.31
Winner converged	yes
Total wall time (s)	963.3
Engine	tumor_fitter (Fase A.1, simplified Hahnfeldt-Can)
$\lambda$ nominal (day <sup>-1</sup> )	0.192
b nominal (day <sup>-1</sup> )	5.85
N observations (mean curve)	15
t range (days)	2.0-70.0

## Methodological notes

Tumor-vasculature dynamics are modeled using a simplified Hahnfeldt-type system (Can 2026) without the  $V^{2/3}$  inhibitor term of the original Hahnfeldt et al. 1999 formulation. Angiogenic rates  $\lambda=0.192/\text{day}$  and  $b=5.85/\text{day}$  are derived from Hahnfeldt 1999 LLC reference values; the inhibition rate  $d=0.30/\text{day}$  is calibrated for plateau dynamics in the simplified system. The original 5-parameter Hahnfeldt 1999 model with full inhibitor term is planned for a later version.

Primary verdict criterion:  $\Delta\text{AIC} \geq 4$  against the next-best model. The regime-detection layer raises this to  $\Delta\text{AIC} \geq 8$  only for Hahnfeldt fractional in short exponential-only observation windows.

The verdict logic includes a regime-detection layer: when the observation window is shorter than the calibrated Hahnfeldt-Can range, Hahnfeldt fractional verdicts require stronger statistical evidence ( $\Delta\text{AIC} \geq 8$ ) to override simpler models. This protects against overfitting in short exponential-only windows.

Fractional order  $\alpha$  is estimated from the data with synthetic validation accuracy  $\pm 0.10$ ; clinical/biological interpretation of  $\alpha$  is the responsibility of the user's expert team.

Phase 2.A roadmap (planned next iteration): re-implement the original 5-parameter Hahnfeldt 1999 model with the  $V^{2/3}$  inhibitor term ( $dV/dt = -\lambda \cdot V \cdot \ln(V/K)$ ;  $dK/dt = -d \cdot K + e \cdot V - g \cdot V^{2/3} \cdot K$ ). The current simplified Can 2026 system captures growth dynamics through the inflection phase; full plateau saturation requires the original formulation.

## Limitations

Current scope: Tumor growth dynamics only. Drug effect (immunotherapy, chemotherapy, anti-angiogenic) is outside the scope of this version — the underlying solver supports treatment schedules ( $u_{\text{imm}}$ ,  $u_{\text{chem}}$ ) but datasets are restricted to control arms. A dedicated PK/PD module with drug-effect terms is planned as a separate engine in a later phase. Per-subject NLME (FOCEI/SAEM) for OMEGA / shrinkage estimation is scheduled for a later phase; the current report uses population-mean fits with WRES as a proxy for CWRES.

## Disclaimer (extended)

This report contains computational results. Pharmacological interpretation and clinical decisions are the responsibility of the client's expert team. FractalPK does not provide medical, pharmacological, or regulatory advice. Models compared by AIC; statistical equivalence threshold  $\Delta\text{AIC} \geq 4$  (raised to  $\geq 8$  for Hahnfeldt

fractional in short exponential-only windows). Verdict is a diagnostic indication, not a regulatory conclusion.