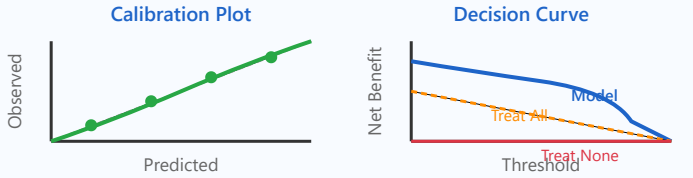
Clinical Risk Scores

Translate complex models into simple, actionable scoring systems

Development Pipeline

1	Select Predictors	Clinical relevance + Statistics
2	Fit Regression	Logistic/Cox regression
3	Convert to Points	β → Integer scores
4	Create Tool	Nomogram/Calculator
5	Validate Externally	Different population

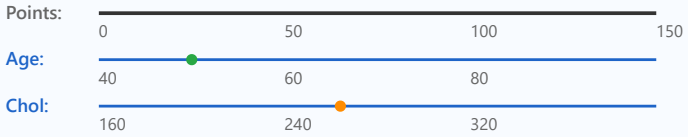
Validation Metrics



Performance Requirements:

- C-index > 0.7
- Good calibration
- Net benefit +
- External val

Example Nomogram: Cardiovascular Risk



Total: 75 points
→ 15% 10-year risk

Low | Med | High

Risk Categories

✓ Clinical Examples

APACHE II (ICU mortality) • Framingham Risk Score (CVD) • MELD Score (liver transplant) • GRACE Score (ACS) • CHA_2DS_2-VASc (stroke risk)

📊 Mathematical Principles Behind Risk Scores

β Coefficient → Point Conversion

Concrete Example: CVD Risk

Step 1: Logistic Regression Model

$\log(p/(1-p)) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots$

Step 2: Scale to Integer Points

$\text{Points}_i = \text{round}(\beta_i / \beta_{min} \times \text{constant})$

Step 3: Total Score = Σ Points → Probability

Example: Age coefficient $\beta = 0.05$
→ Points per year = $0.05/0.01 \times 2 = 10$

Variable	β Coefficient	Points
Age (per 10y)	$\beta = 0.50$	+25 pts
Smoking (Yes)	$\beta = 0.80$	+40 pts
Diabetes (Yes)	$\beta = 0.60$	+30 pts
Hypertension	$\beta = 0.40$	+20 pts

Patient: Age 60, Smoker, Diabetic

Total = 50 + 40 + 30 = 120 points

→ 10-year CVD risk = 28%

Score → Probability Conversion Methods

Method 1: Lookup Table

Total Score	Risk %
0-40	<5%
41-80	5-15%
81-120	15-30%
>120	>30%

✓ *Simple, clinician-friendly*

Method 2: Direct Formula

$p = 1 / (1 + e^{-LP})$

LP = linear predictor from score

Score = 120 → LP = 0.06×120 - 3.5
→ p = 28.3%

Key Insight: Risk scores transform complex regression models into simple integer addition. The scaling factor is chosen to balance precision (enough granularity) with simplicity (easy mental math). Typically, total scores range 0-200 points for optimal usability.