Digital Transformation of Healthcare

Evaluating Predictions

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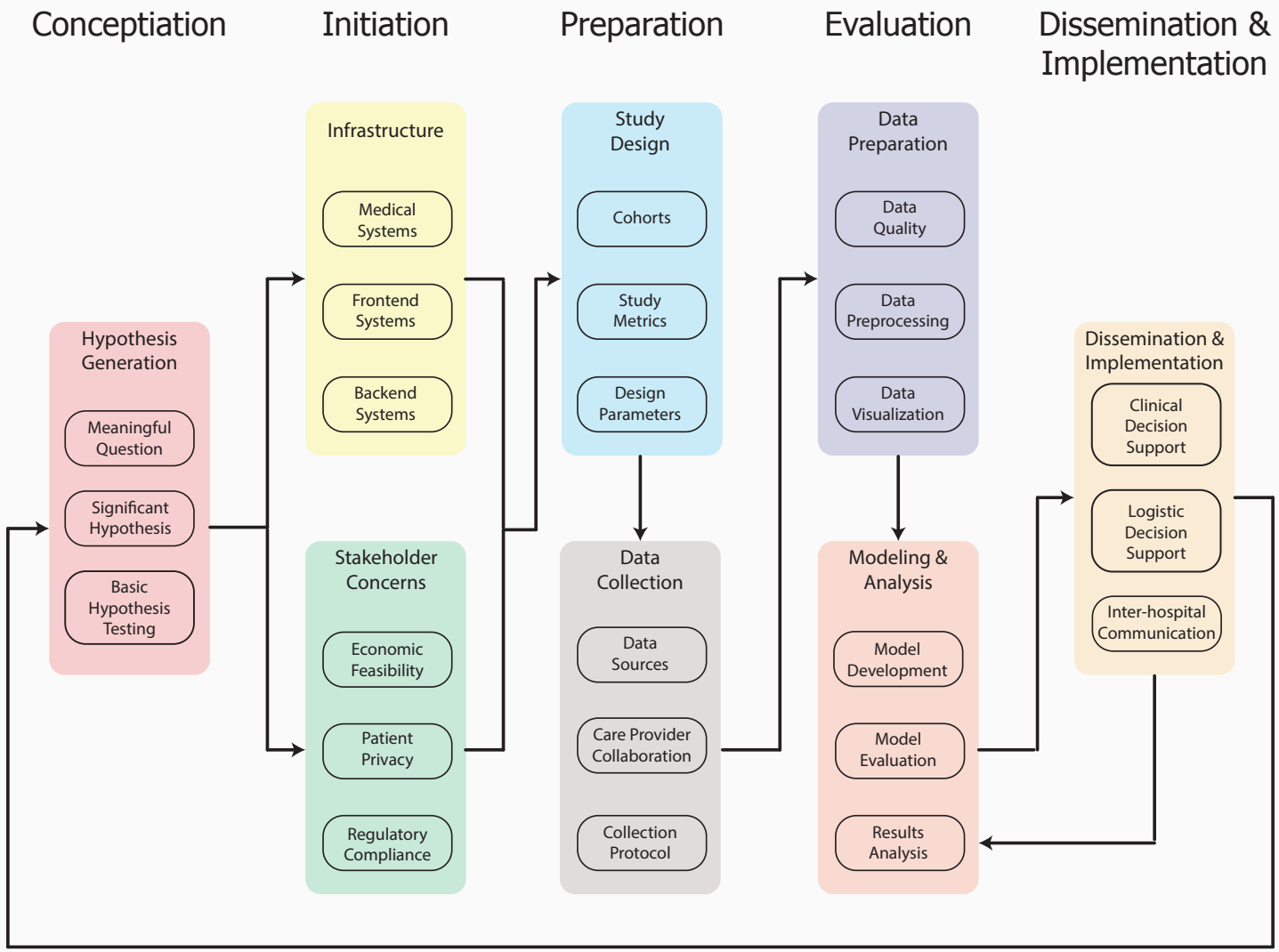
Evaluating Predictions

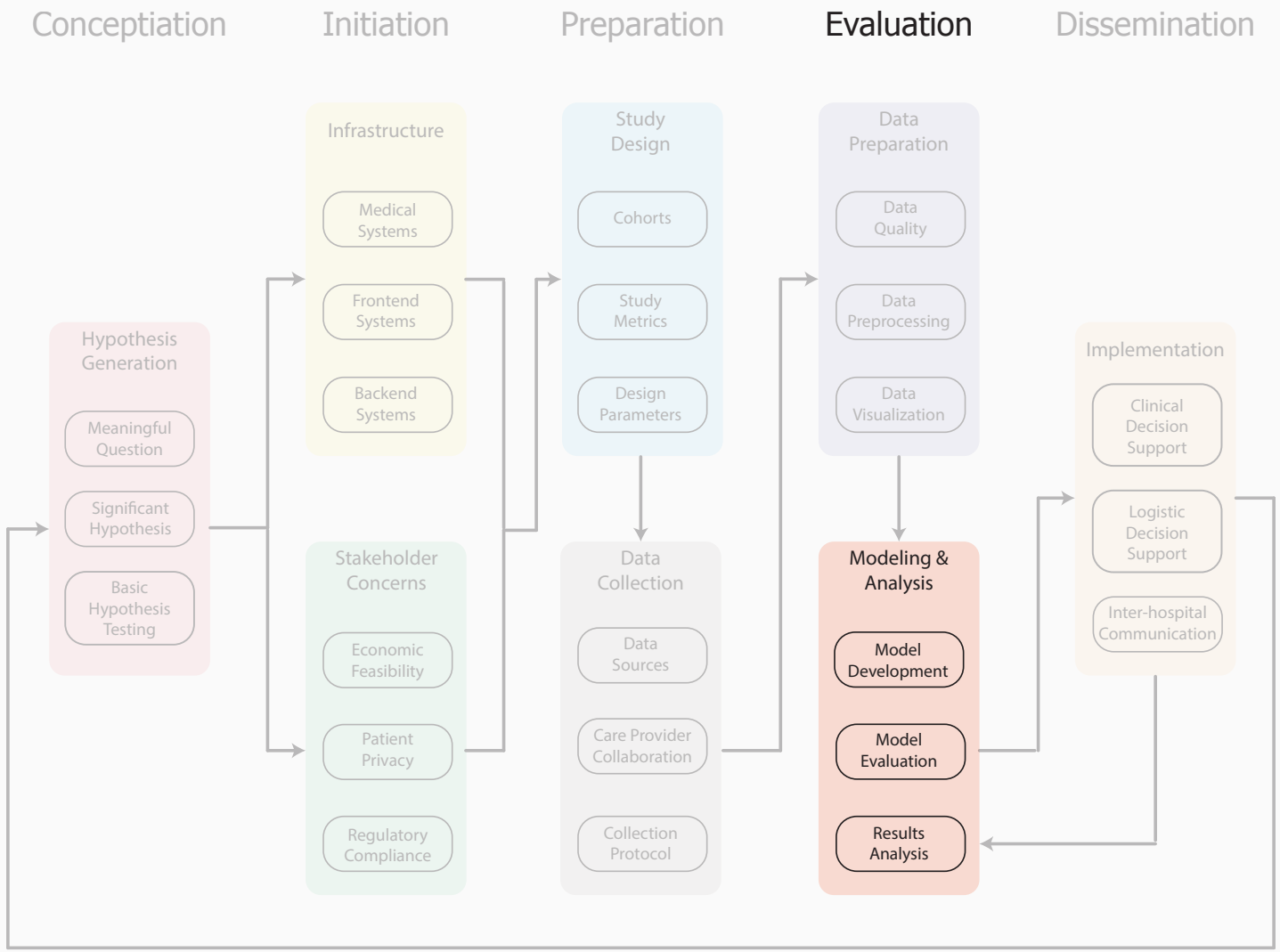
After this lecture students will be able to

- Calculate common classification and regression metrics
- Describe the role of simple classification metrics
- Evaluate the implementation of metrics for a study
- Articulate the information underlying common compound classification metrics
- Classify regression metrics
- Connect regression metric outcomes to facets of the associated models
- Identify transition points which can affect data quality
- Discuss methods for measuring and evaluating data quality

Bioinformatics Pipeline



Evaluating Predictions



Metrics for Evaluation of Classification Models

Terms and Questions

Terms

- Accuracy
- Specificity
- Sensitivity
- Positive Predictive Value
- Negative Predictive Value
- Likelihood Ratio
- ROC & AUC
- F1 Score

Questions

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Questions

- Is accuracy a useful metric?
- What information is conveyed by sensitivity vs specificity ?
- What information do the PPV and NPV add?
- Intuitively, how do sensitivity, specificity, likelihood ratios and ROC connect?
- Is the F1 score a more robust metric than the ROC and AUC?

Clinical Cases

- Low dose CT for detecting lung cancer (LDCT)[1]
- Ultrasound detection of abdominal aortic aneurysms (AAA)[2]
- Blood pressure monitoring in adolescents using home machines (HTN)[3]
- Detecting suicidality among adolescent outpatients by clinicians versus trained raters using the Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS-PL) [4]

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[1] National Lung Screening Trial Research Team. (2011). Reduced lung-cancer mortality with low-dose computed tomographic screening. New England Journal of Medicine, 365(5), 395-409.

[2] Thompson, S. G., Ashton, H. A., Gao, L., Buxton, M. J., Scott, R. A. P., & Multicentre Aneurysm Screening Study (MASS) Group. (2012). Final followup of the Multicentre Aneurysm Screening Study (MASS) randomized trial of abdominal aortic aneurysm screening. British Journal of Surgery, 99(12), 1649-1656.

[3] Stergiou, G. S., Nasothimiou, E., Giovas, P., Kapoyiannis, A., & Vazeou, A. (2008). Diagnosis of hypertension in children and adolescents based on home versus ambulatory blood pressure monitoring. Journal of hypertension, 26(8), 1556-1562.

[4] Holi, M. M., Pelkonen, M., Karlsson, L., Tuisku, V., Kiviruusu, O., Ruuttu, T., & Marttunen, M. (2008). Detecting suicidality among adolescent outpatients: evaluation of trained clinicians' suicidality assessment against a structured diagnostic assessment made by trained raters. BMC psychiatry, 8(1), 97.

Confusion Matrix

Lung Cancer

Low-Dose CT	p	n
p′	649	17,497
n′	5,532	49,792

AAA

Ultrasound	p	n
p′	600	734
n′	61	25,480

HTN

Home Machine	p	n
p′	17	6
n′	14	65

K-SADS-PL

Trained Clinician	p	n
p′	32	23
n′	30	133

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- When are sensitivity, specificity, PPV and NPV appropriate tests?

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- Are these good screening tests and/or diagnostic tests?
- How does the PPV and NPV affect your opinion of their utility?
- When are sensitivity, specificity, PPV and NPV appropriate tests?
- How are sensitivity, specificity, PPV and NPV affected by prevalence?

Combined Statistics

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- What are the different ways to combine the base stats into summary statistics (hint: what are the basic ways to combine any numbers)?
  - Work through each of the four clinical cases

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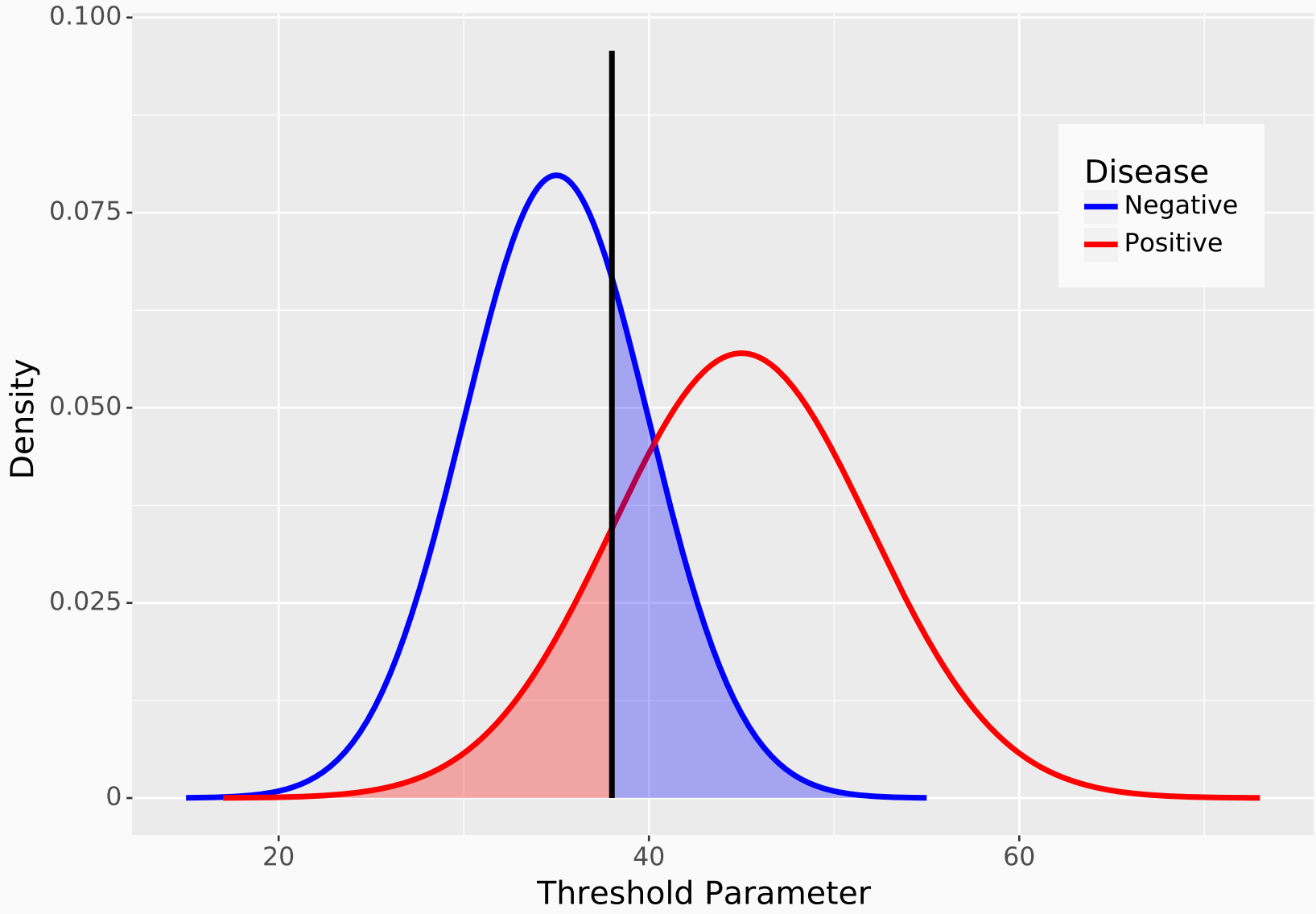
- What are 4 'sensible' pairings of the base stats
- What are the different ways to combine the base stats into summary statistics (hint: what are the basic ways to combine any numbers)?
  - Work through each of the four clinical cases
- What determines the split of positive cases into TP vs FN and negative cases into TN vs FP?

Hypothesis Testing



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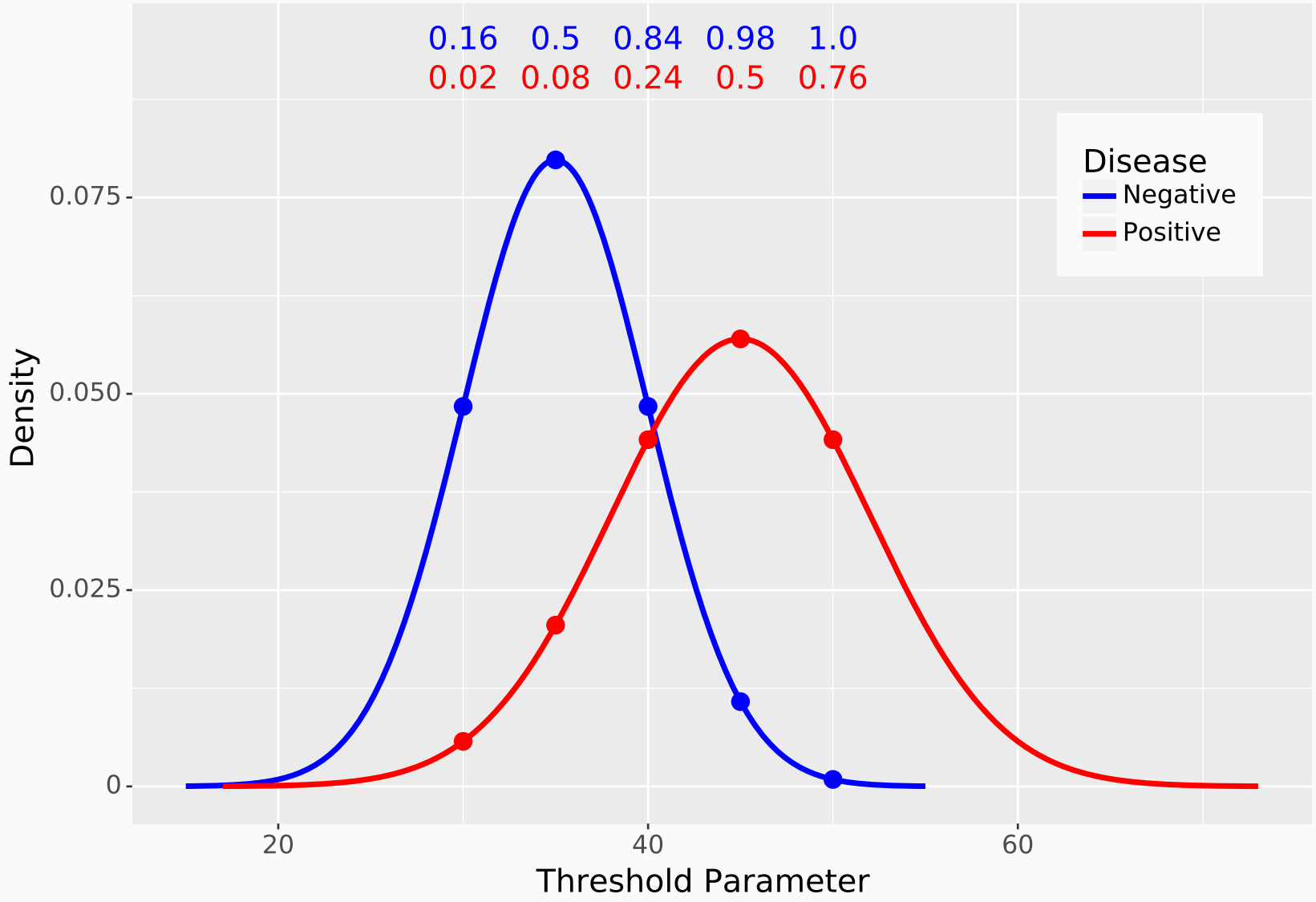
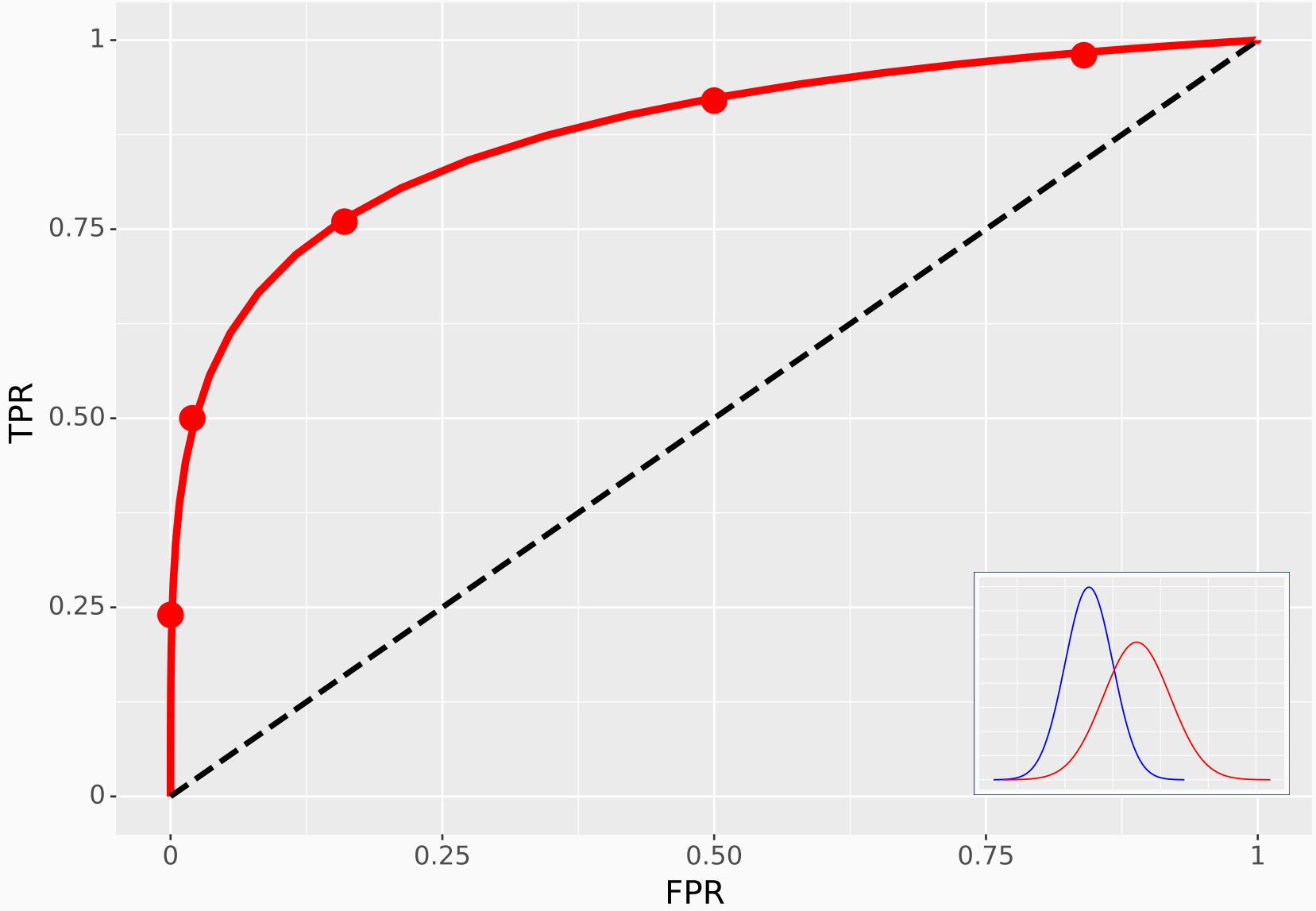


Receiver Operating Characteristic



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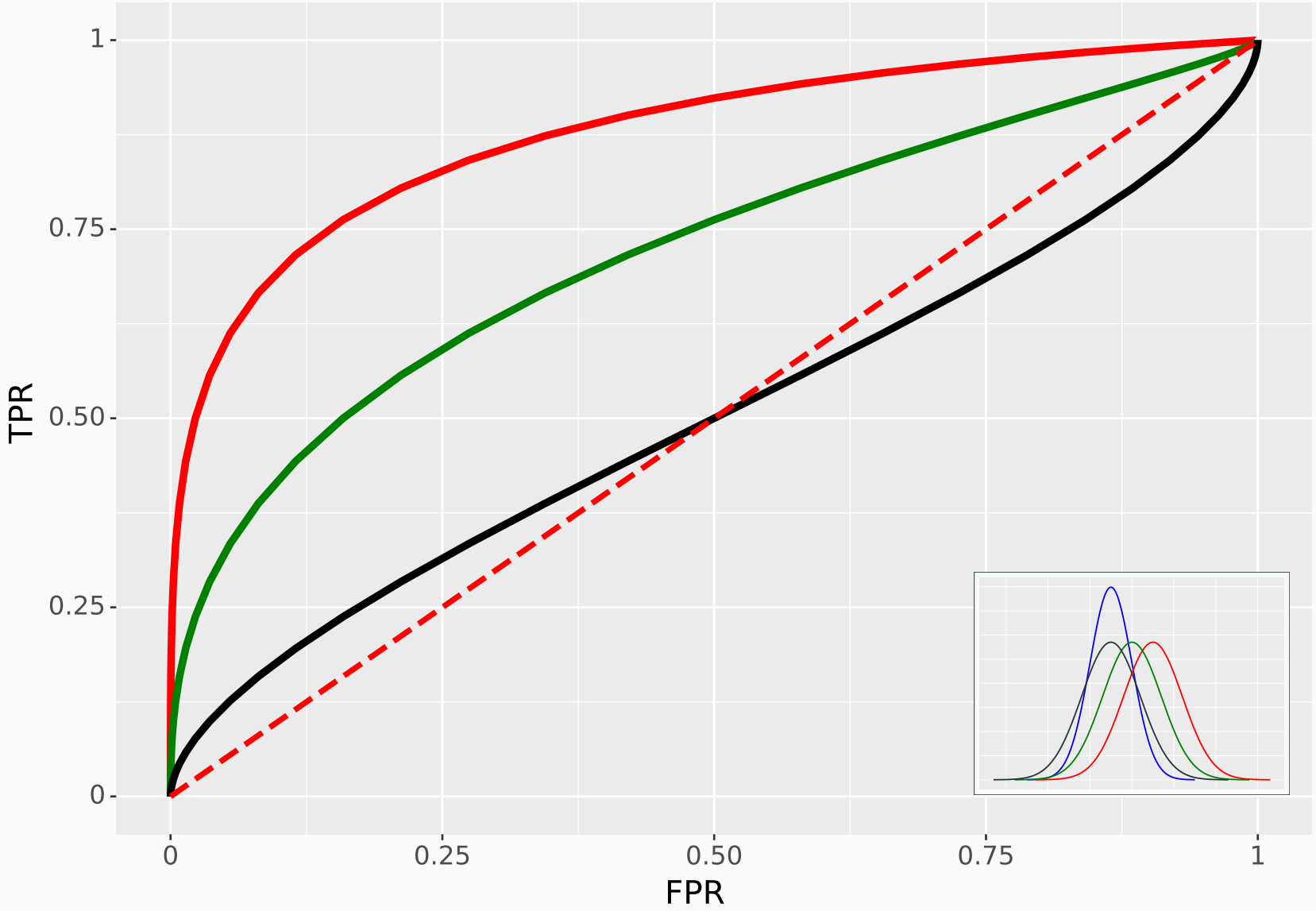
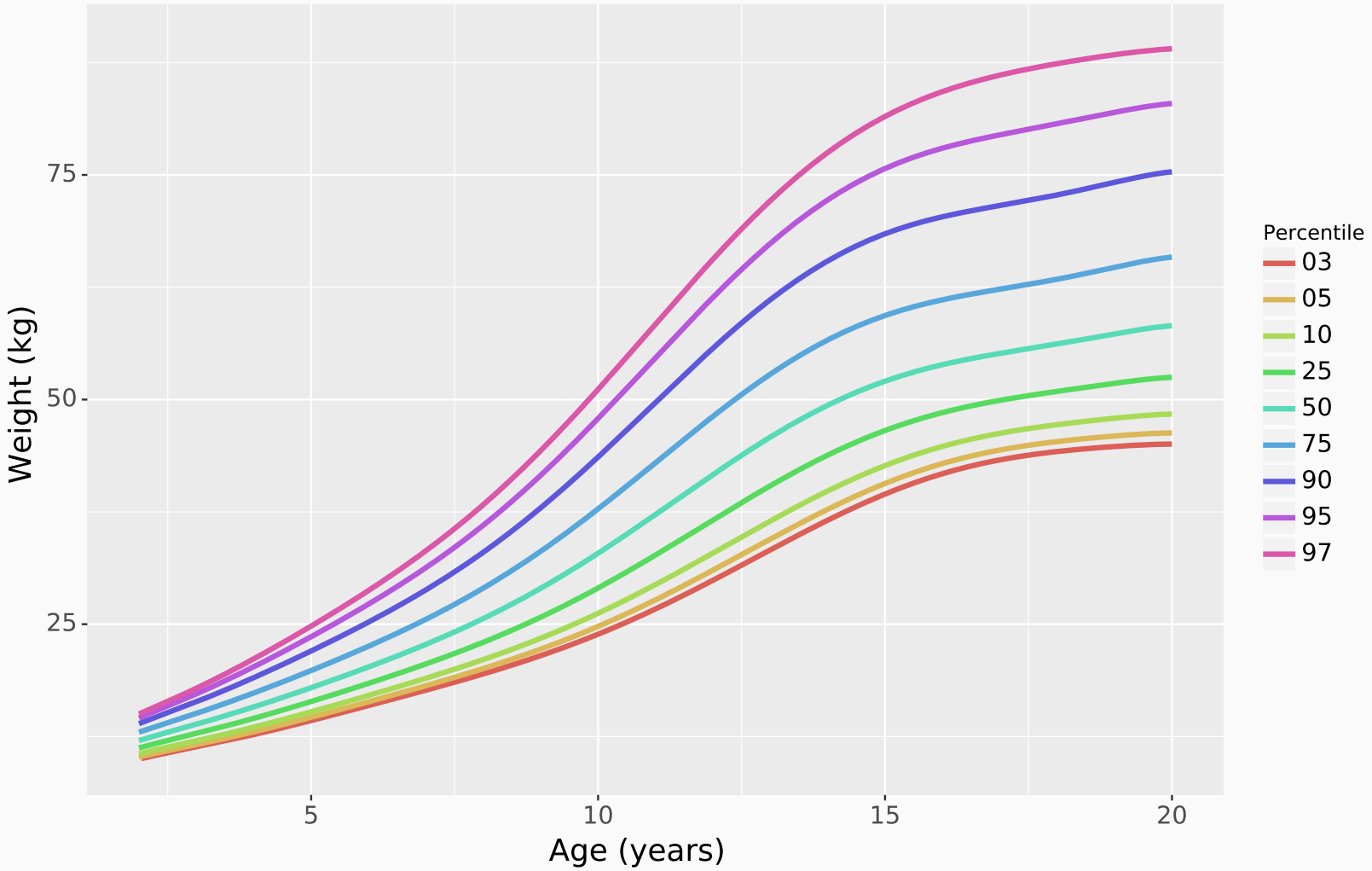


Metrics for Evaluation of Regression Models

Growth Curves



Centers for Disease Control and Prevention, National Center for Health Statistics. CDC growth charts: United States.

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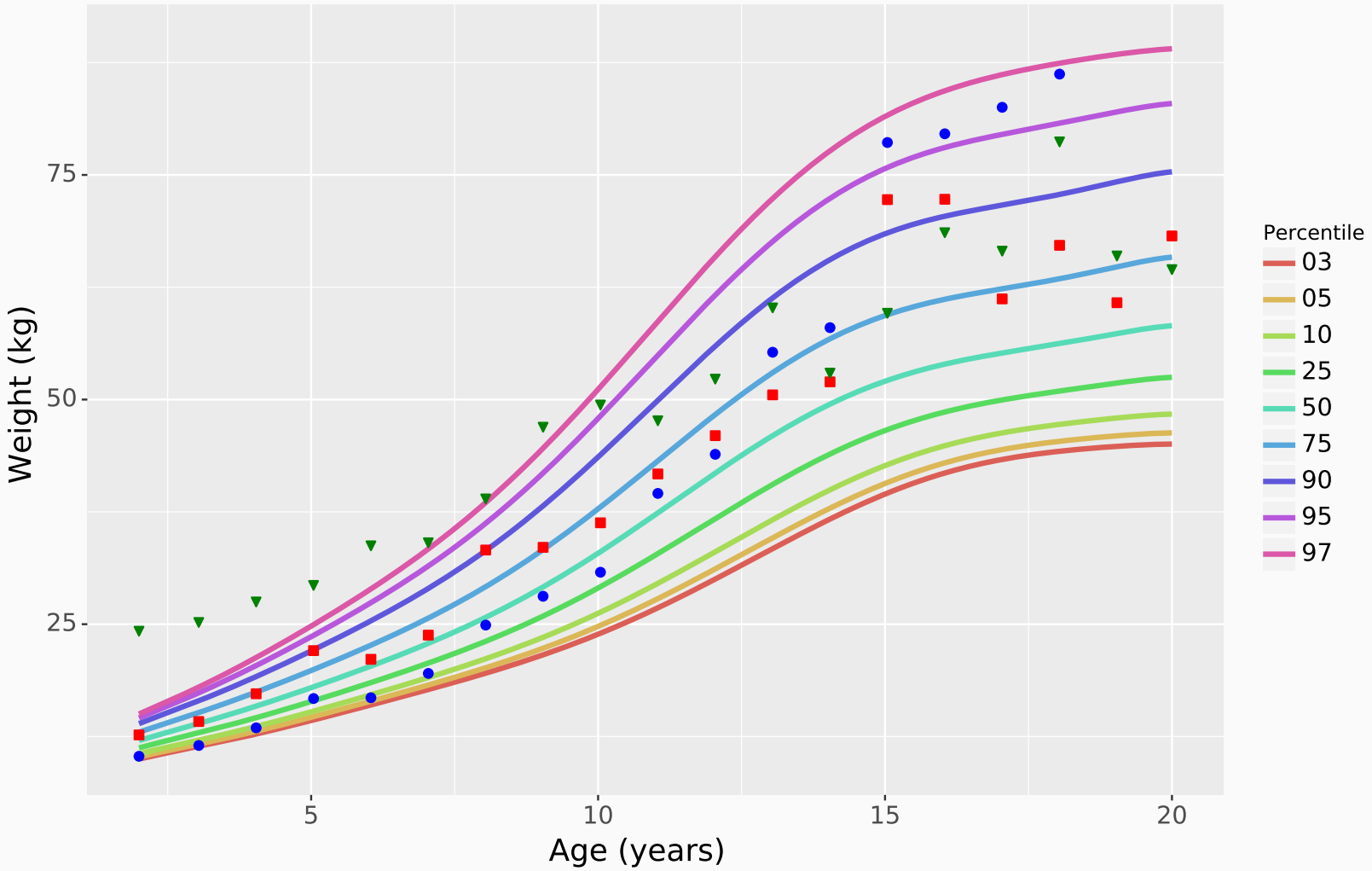

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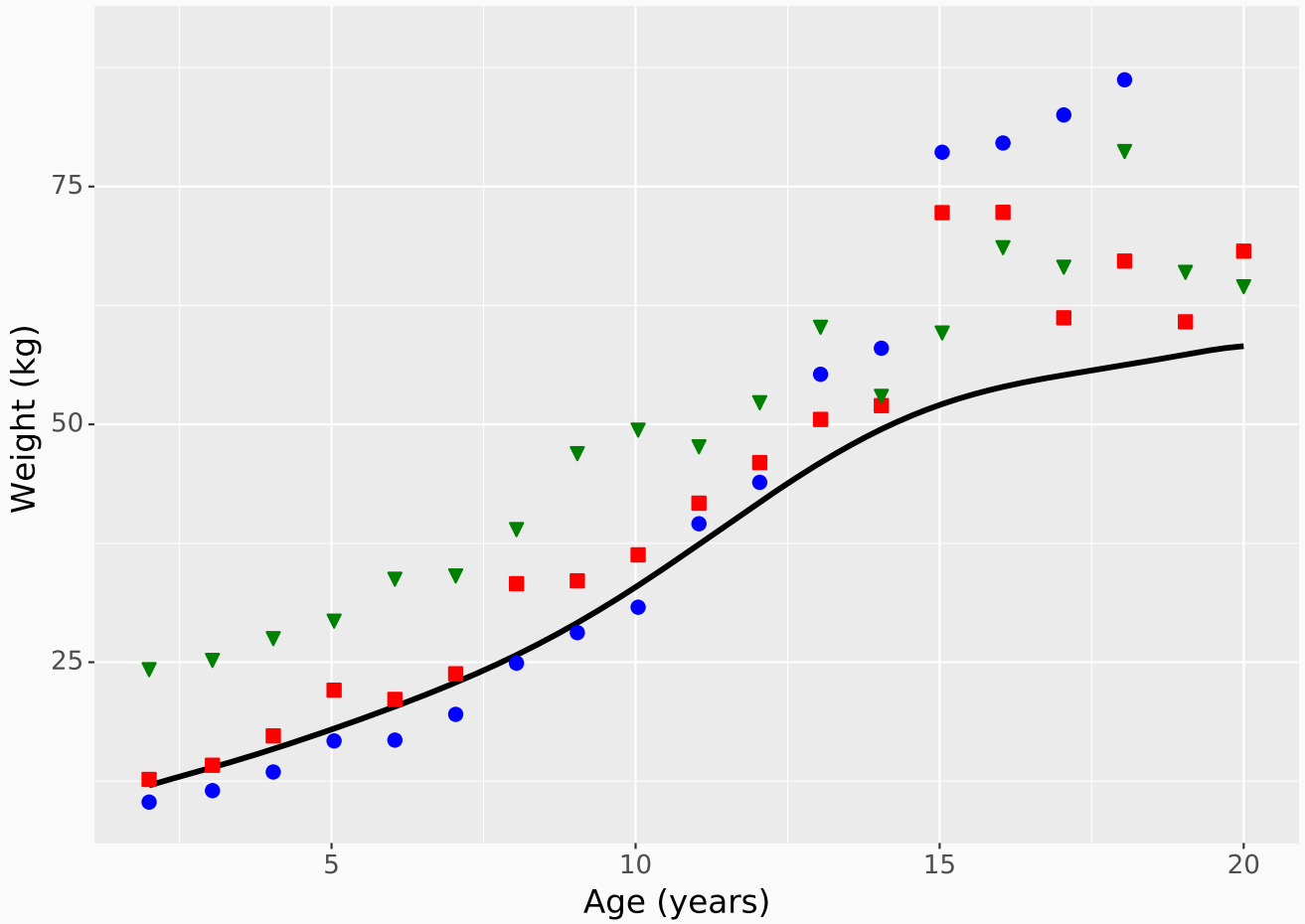
Regression Metrics



- What aspects of a model's predictions should I care about?
- What aspects of the model's predictions can I evaluate?