



Issues in Credit Scoring



Model Development and Validation

Dennis Glennon

Risk Analysis Division

Economics Department

The Office of the Comptroller of the Currency

The opinions expressed are those of the author and do not necessarily reflect those of the Office of the Comptroller of the Currency.



Model Development and Validation

Outline

1. Credit Risk vs. Model Risk
2. Model Risk Analysis
3. Model Purpose
 - i. Classification
 - ii. Prediction



Model Review

Scope of a Review

I. Credit Risk

The risk to earnings or capital of an obligor's failure to meet the terms of any contract with the bank or otherwise fail to perform as agreed.

II. Model Risk

Although model risk contributes to the overall portfolio or credit risk, it represents a conceptually distinct exposure that emerges from an overly broad interpretation or application of a model beyond that for which it was developed.



Model Review

Scope of a Review

- I. Credit Risk Analysis
 - i. evaluate strategies
 - ii. assess current portfolio performance

- II. Model Risk Analysis
 - i. evaluate model validity, reliability, and accuracy



Model Review

Model Risk Analysis

- I. Are the models developed using valid statistical or industry-accepted methods?
 - i. Appropriate sample design
 - a. truncated/censored samples
 - b. over-sample



Model Review



Model Risk Analysis (continued)

- ii. Valid model design
 - a. satisfy minimum statistical requirements
 - b. in-sample performance (including holdout sample)
 - c. out-of-time performance



Model Review



Model Risk Analysis (continued)

- II. Are the models used in ways that are consistent with the original purpose for which the model was developed?
 - i. Model purpose
 - a. classification
 - b. prediction

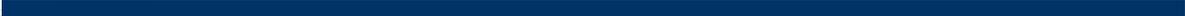


Model Purpose

Model Purpose

The underlying objective of a classification-based model is different from that of a prediction model.

As such, a model should be evaluated within the scope of its primary objective.



Model Purpose



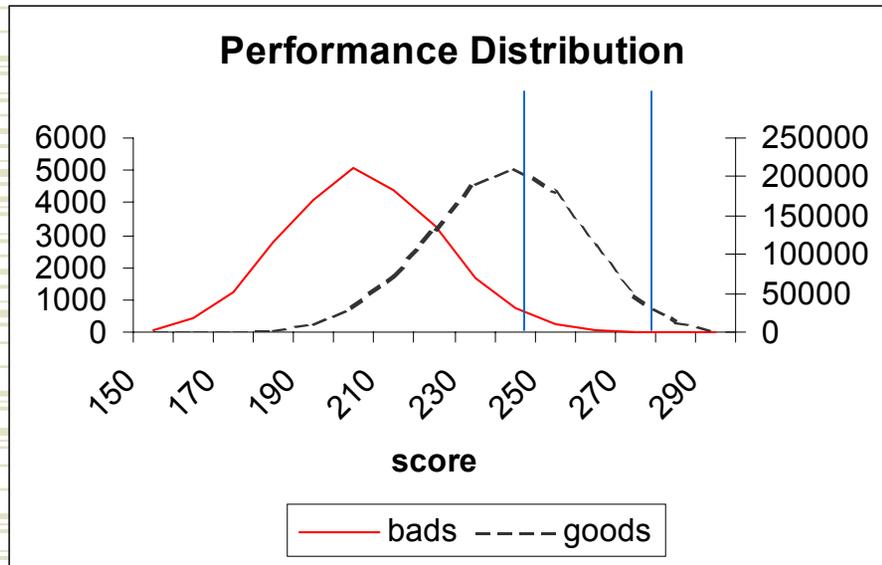
Models as Classification Tools

Banks are developing or purchasing models that are designed as *classification* tools. That is, the models are developed for the purpose of partitioning populations or portfolios into groups by their expected *relative* performance.

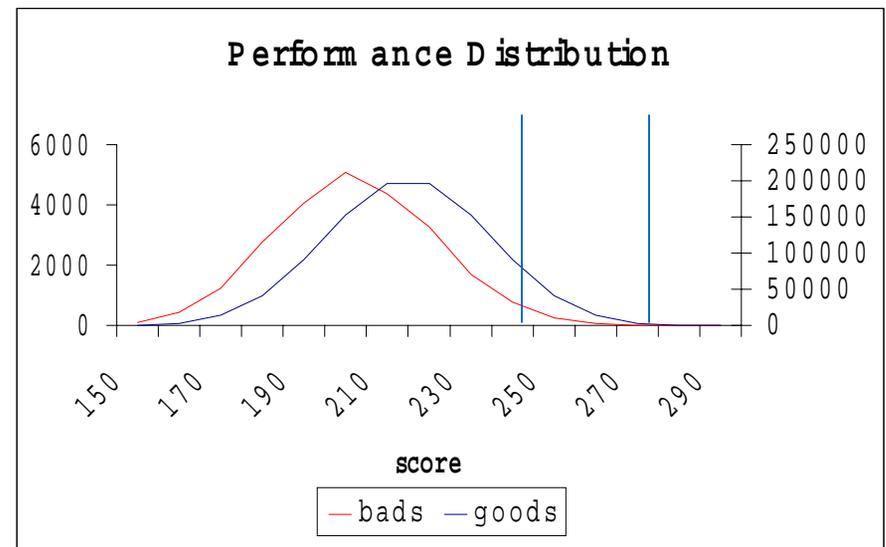
Modeling Objective: Maximize the divergence or separation between the distributions of good and bad accounts.

Classification Design: Example

A Comparison of Model Performance



K-S = 64.0



K-S = 26.5

Model Purpose

Classification Objective

Interpretation: If, for example, the good/bad odds ratio associated with the score interval between 200-210 is 30:1, then the odds ratio for the intervals above (below) 200-210 will be greater (less) than 30:1.

Result: A model that maintains its ability to rank-order performance is considered to be *reliable*.



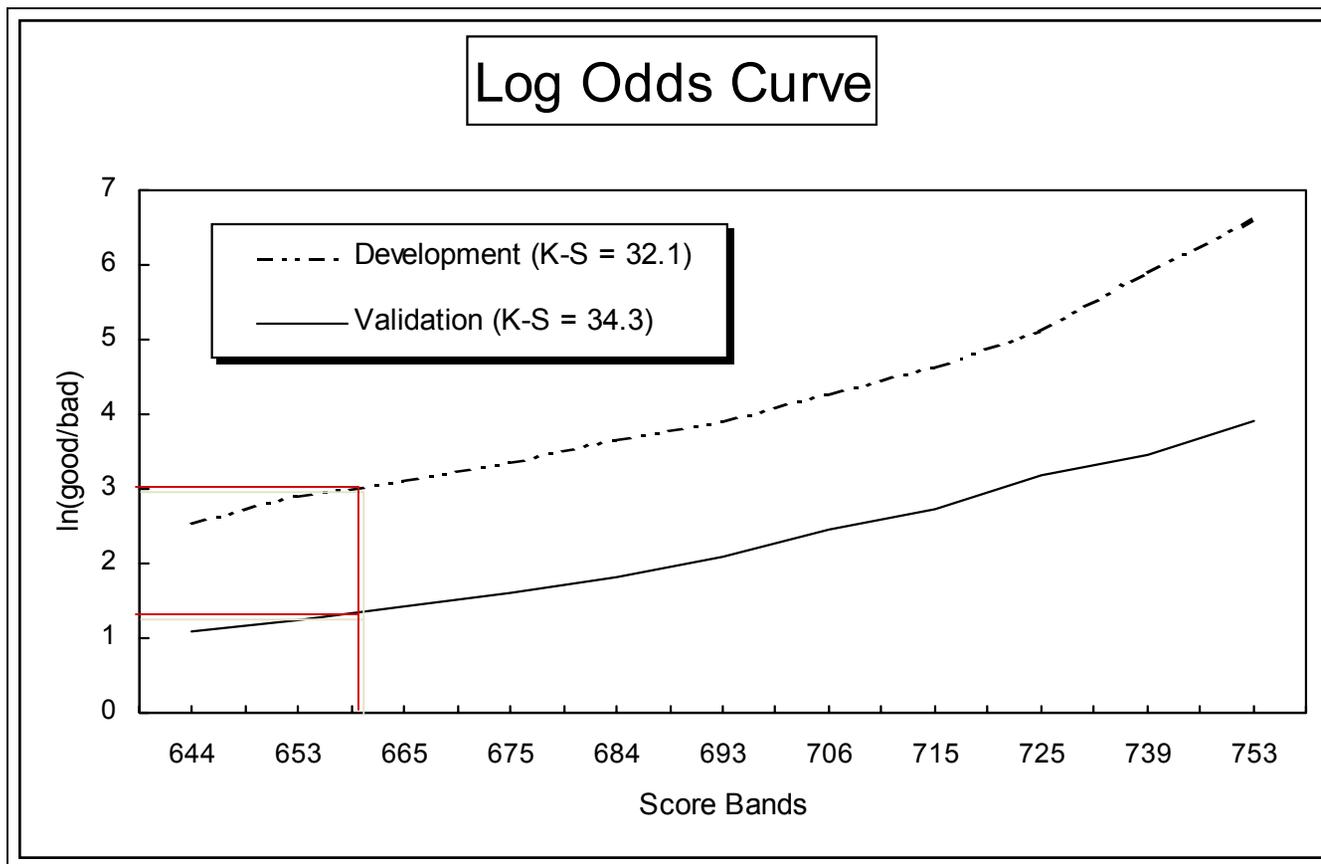
Model Purpose

Classification-Based Models

Valid Purpose: models developed under this criteria are valid as decision tools if the objective is to simply identify segments of the population that, as a group, perform poorly.

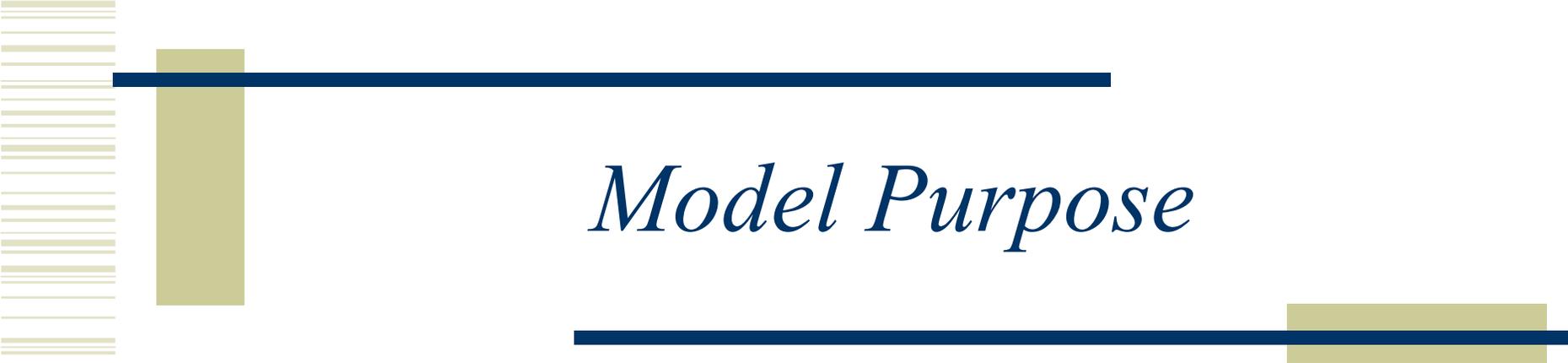
Appropriate for identifying and excluding specific segments of the population -- a strategy that, in practice, often improves average portfolio performance relative to a random-selection method.

Classification Model



$\ln(20/1) = 3$
bad rate = .05

$\ln(4/1) = 1.39$
bad rate = .20



Model Purpose

Alternative Purpose: Predicting Performance.

Banks want models for risk-based pricing/re-pricing and profitability analysis -- models that are designed specifically to address the issue of trading risk for margin (i.e., return).

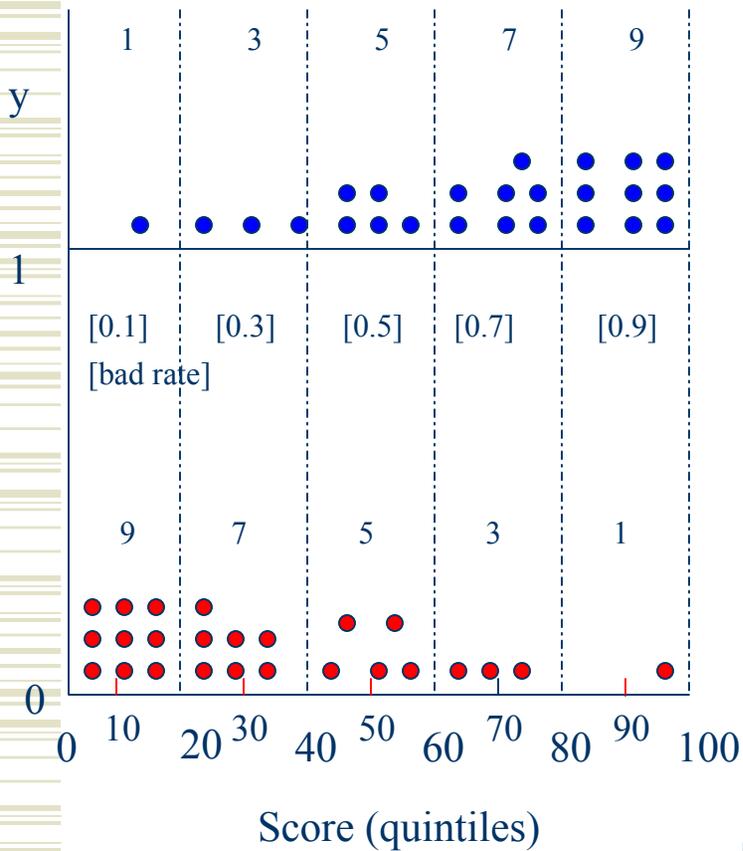
For that purpose, banks need models that are *accurate* predictors of performance.

Model Selection: Which model is *better*?

● obs. good (G) - $y=0$ ● obs. bad (B) - $y=1$

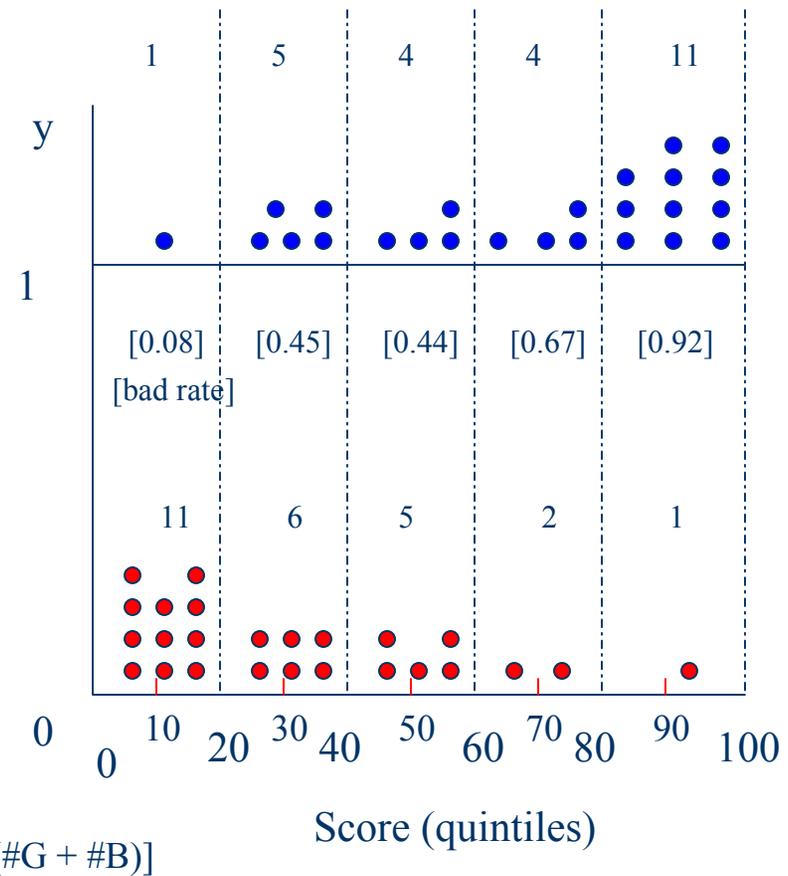
K-S = 48

Model 1



K-S = 48

Model 2





Model Purpose: Prediction

Models as Prediction Tools

Purpose: to predict the expected frequency at which accounts with similar attributes perform (e.g., respond, attrite, default). For example, predict the probability of default.

Modeling Objective: Minimize the difference between the predicted and actual percentage of defaults within each score range (i.e., maximize the goodness-of-fit).

Model Purpose: Prediction

Prediction-Based Models

Interpretation: If within the interval 200-210 the risk model predicts a probability of default of .04, then for every 100 account that score within that range, four should default.

A model that satisfies this condition is considered to be *accurate*.

This is a much stronger condition than that associated with a classification objective (i.e., reliable).



Model Purpose: Prediction

Prediction-Based Models

Valid Purpose: models developed under this approach are valid as actuarial tools; as such, they are appropriate in situations in which the actual, not just the relative, measure of performance is required.



Model Purpose: Prediction

Limitations of a Prediction-Based Model

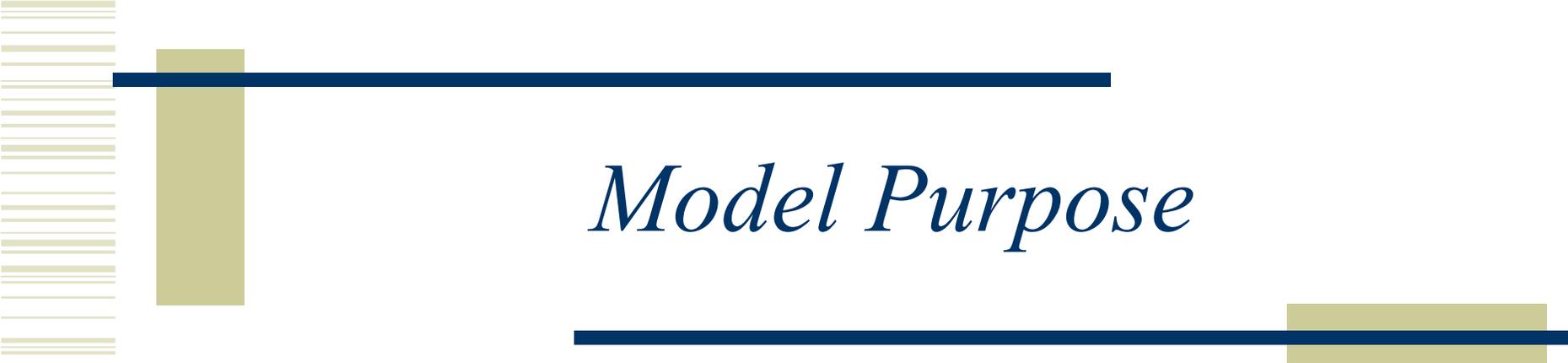
The model-development process is significantly more complex especially when data across all aspects of the behavior decision (i.e., individual, market, and industry) are limited.

Model Purpose

Conclusion: Models are developed for different purposes -- e.g., classification or prediction. As such, the choices of:

- sample design,
- modeling technique, and
- validation procedures

are driven by the intended purpose for which the model will ultimately be used.



Model Purpose

Observation: The choice of modeling objective is important not only because it defines how we assess its validity, but also because it defines a full set of technical estimation procedures that are used to select the “best” model under the chosen objective.



Issues in Credit Scoring



Model Development and Validation

The End