# Bootstrap Hypothesis Tests in Credit Risk

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# Bootstrapping in Credit Risk

- Generally underutilized in the credit risk area.
- Bootstrapping finds application across various domains within credit risk modeling.
- Particularly useful for testing metrics where there is little consensus on the standard error of the estimate or when statistical testing procedures are absent.
- Various methods exist for calculating bootstrap confidence intervals and p-values, with the percentile method likely being the most commonly used. Computing the p-value is not always straightforward because bootstrapping does not produce data conforming to the null hypothesis.
- The examples from the following slides demonstrate the percentile method with centered values as: `estimate - bootstrapped distribution + null hypothesis value` and with the p-value calculated as a percentage of more extreme values than the estimate.
- Advantages:
  - does not rely on any distributional assumption
  - flexible application across a wide range of metrics
  - useful for identifying bias
  - easy to implement.
- Disadvantages:
  - computational intensity
  - assumption of independence (although this can be addressed to a certain extent)
  - accuracy concerns for smaller sample sizes.

# Example 1: Population Stability Index (1-sided test)

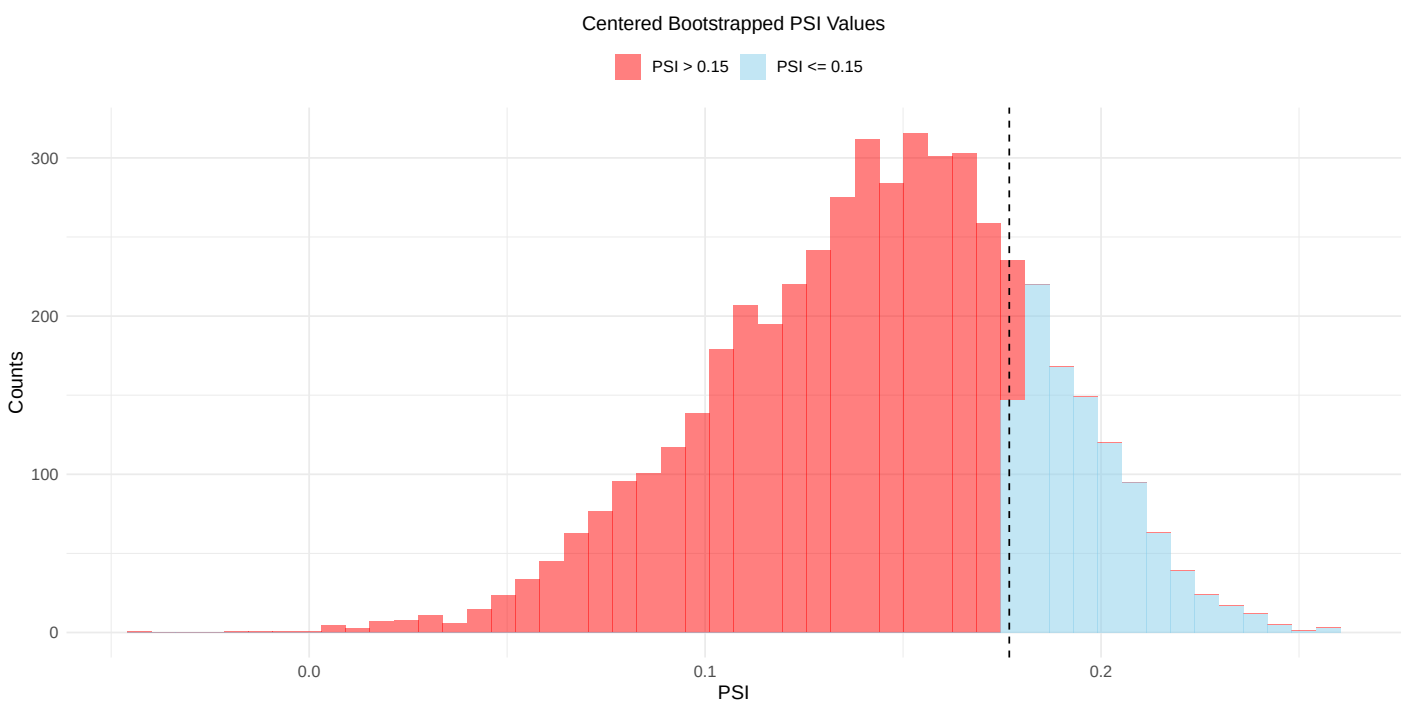
## Dataset:

```
##   Bin Base cnt. Base pct. Target cnt. Target pct.  PSI
## 1   1       119      0.22         155        0.35 0.18
## 2   2       130      0.24         139        0.31 0.18
## 3   3        39      0.07          24        0.05 0.18
## 4   4       263      0.48         131        0.29 0.18
```

## Testing Hypothesis:

$H_0 : PSI \leq 0.15$

## Visualization:




## p-value:

```
## [1] "21.26%"
```

# Example 2: Herfindahl-Hirschman Index (1-sided test)

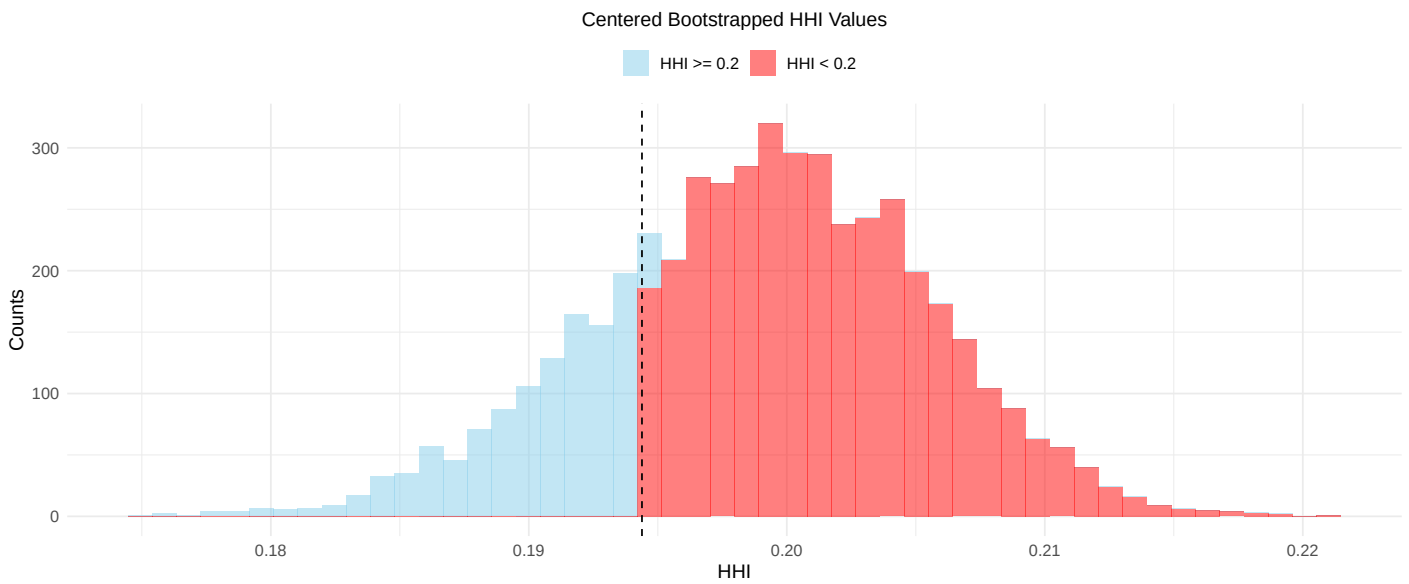
## Dataset:

```
##         Rating Grade # obs.   DR   HHI
## 1   01 (-Inf,0.0199)    202 0.01 0.194
## 2 02 [0.0199,0.0263)     54 0.02 0.194
## 3 03 [0.0263,0.0369)     96 0.03 0.194
## 4 04 [0.0369,0.0903)    204 0.06 0.194
## 5   05 [0.0903,0.15)    103 0.11 0.194
## 6    06 [0.15,0.197)     41 0.12 0.194
## 7     07 [0.197,Inf)     50 0.32 0.194
```

## Testing Hypothesis:

$H_0 : HHI \geq 0.20$

## Visualization:




## p-value:

```
## [1] "23.72%"
```

# Example 3: Area Under Curve (2-sided test)

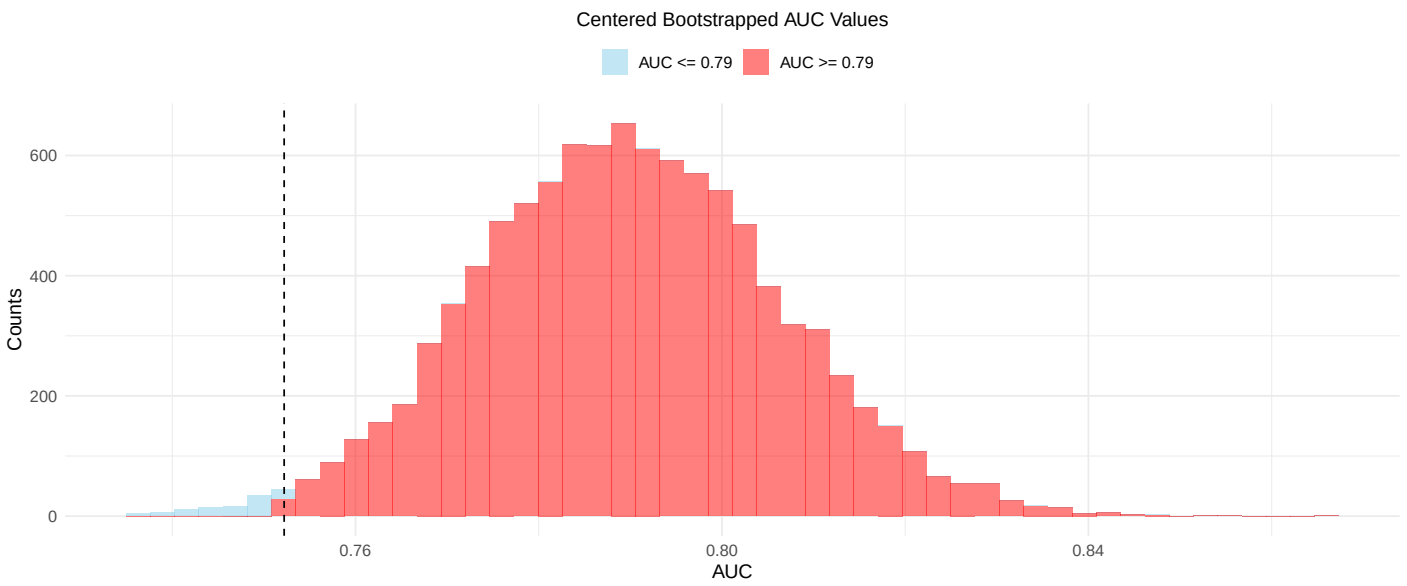
**Dataset:**

Development sample AUC 79%. Application portfolio AUC 75.2%.

**Testing Hypothesis:**

$H_0 : AUC = 0.79$

**Visualization:**




**p-value:**

2*min(c(left-side p-value, right-side p-value))

```
## [1] "2.06%"
```