Quiz 7. Two Topics: (1) Splines, (2) Shrinkage Methods

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Splines

1. A B-spline is fit with the following basis functions

$$\begin{cases} b_1(X) = 0 & \text{for } -10 \le X \le r \\ b_2(X) = X^2 & \text{for } r < X \le s \\ b_3(X) = X - 1 & \text{for } s < X \le 10 \end{cases}$$

The corresponding coefficients are: $\beta_0 = 0$, $\beta_1 = 1$, $\beta_2 = 0.5$, $\beta_3 = 2$.

(a) Find the knots *r* and *s* that will be suitable for the b-spline. (Hint: the neighboring splines are continuous at the knots.)

Y_hat = 0 + 1*b1(x) + 0.5* b2(x) + 2 * b3(x)

If -10 <= X <= r, Y hat= 0 + 1*0 + 0.5*0 +2*0 = 0

If r <x <=s, Y_hat = 0+1*0 + 0.5*x^2 + 2*0 = 0.5*x^2

If s < x <= 10, Y_hat = 0+1*0 +0.5*0 +2(X-1) = 2(x-1)

At x = r, by A, Y_hat = 0

By B, y_hat = r^2

Continuous → 0 = 0.5r^2, solve for r → r = 0

At x = s, by B, Y_hat =0.5s^2

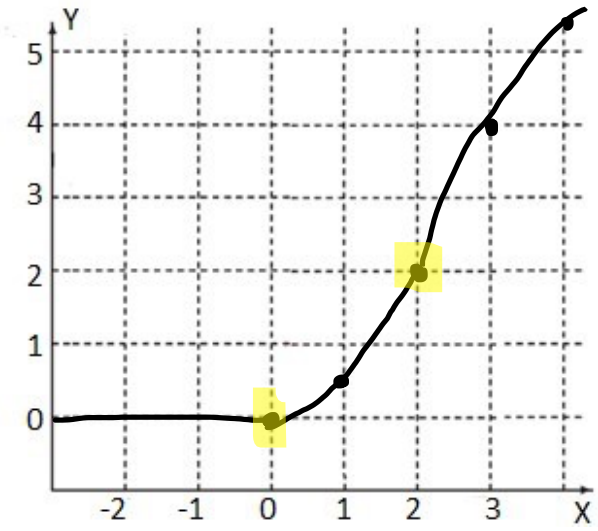
By C, Y_hat = 2(s-1)

Continuous → the above two expressions are equal → solve for s

0.5s^2 = 2(s-1) = 2s-2 → 0.5s^2 = 2s -2 → 0.5s^2 – 2s +2 = 0 → $s^2 - 4s + 4 = 0$ → (s-2)^2 = 0 → s = 2

The suitable knots are r = 0 and s = 2.

(b) **(Stat-627 Only)**. Sketch the B-spline. Visually verify if the connections at the knots are smooth.



Continue to next page for more questions.

Shrinkage Methods:

*Circle **all** correct answers. There may be more than one correct choice.*

2. Which of the following are shrinkage methods?
   (a) Ridge regression (b) LASSO (c) Neither Ridge regression nor Lasso

3. Which of the following(s) can be used as a variable selection method?
   (a) Ridge regression (b) LASSO (c) Neither Ridge regression nor Lasso

- *Fill the blanks with "**will not**", or "**may**", or "**always**".*

4. Compared to the least squares regression, the ridge regression and lasso:

   (a) Will not reduce the bias of the slope's estimate .

   (b) may reduce the standard error or the slopes' estimate.

   (c) May reduce the mean-squared error of prediction.

There will be another question on Shrinkage Methods in the next quiz.