3. Review

Meaning of conditional expectation

2/3 points (graded)

Consider the model $Y|\mathbf{X} \sim \mathcal{N}\left(\mathbf{X}^T\beta, 1\right)$, where $\mathbf{X}$ is a p-dimensional random variable. Here, β is a fixed constant. Indicate whether the following statements are true, or false.

$\mathbb{E}\left[Y|\mathbf{X}\right]$ is a constant random variable.

- (•) True ✖
- ( ) False ✔

If X_i's are iid Gaussian, then the conditional mean, $\mathbb{E}\left[Y|X\right]$ is Gaussian random variable. (Assume β is a real-valued vector).

- (•) True ✔
- ( ) False

The expected value of Y, $\mathbb{E}\left[Y\right]$ is a non-constant random variable, if we assume that each X_i has mean μ.

- ( ) True
- (•) False ✔

Solution:

- False. Note that the conditional mean is equal to $\mathbf{X}^T\beta$, which indeed is a random variable.
- True. Note that $\mathbf{X}^T\beta = \sum_{i=1}^{p} X_i\beta_i$ is a sum of iid Gaussian random variables, and is itself a Gaussian random variable.
- False. Note that $\mathbb{E}\left[Y\right] = \mathbb{E}\left[\mathbb{E}\left[\backslash\mathbf{Y}|\mathbf{X}\right]\right] = \mathbb{E}\left[\mathbf{X}^T\beta\right] = \sum_{i=1}^{p}\beta_i\mu$, which is constant, using the law of iterated expectations.

Submit You have used 1 of 1 attempt

Answers are displayed within the problem

Generalizing Two Components of Linear Models

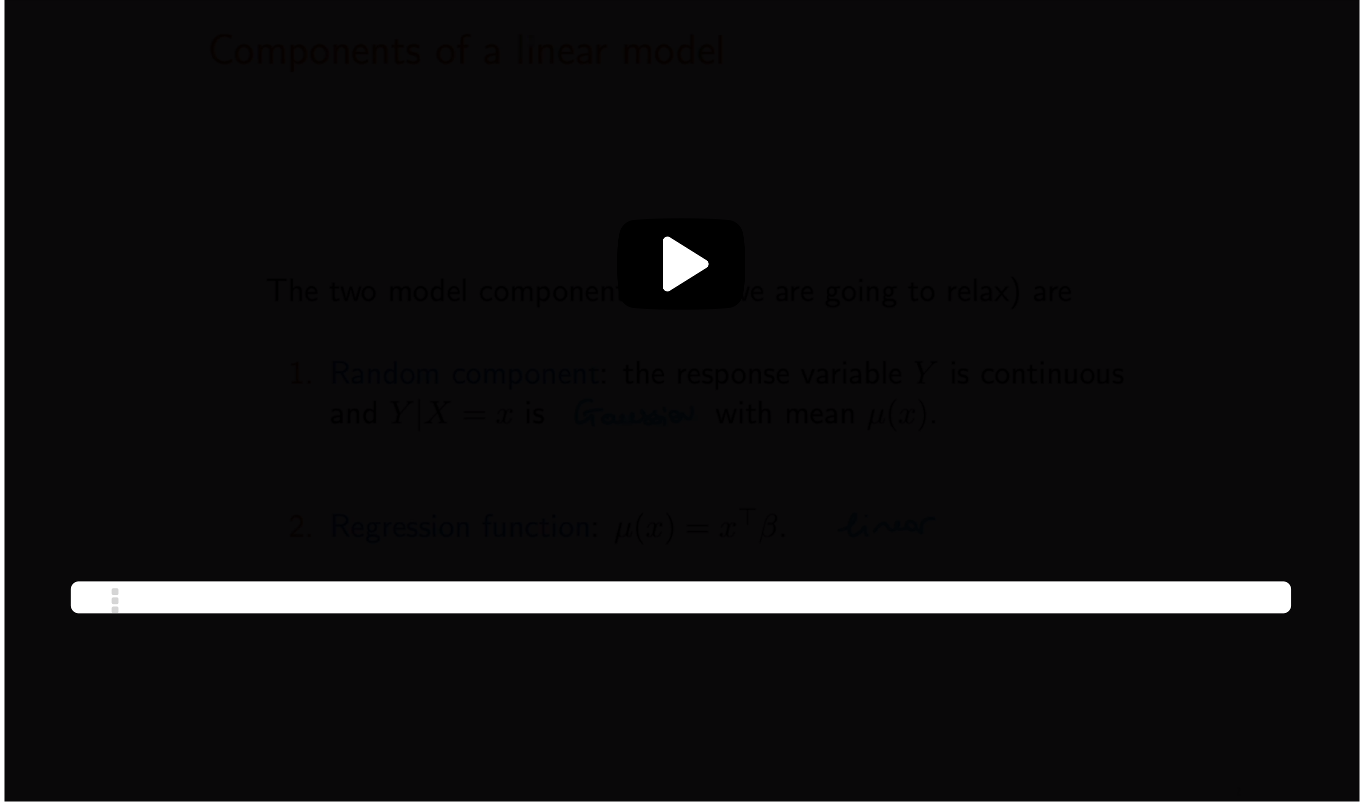
in two different directions.

So the first component was this random component.

So the response variable was assumed to be continuous.

And y given x was assumed to be Gaussian, with mean mu of x.

And the second component was that the



And the second component was that the regression function

mu of x was x transpose beta.

So that was a linear.

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Previously, we encountered the idea of a **regression function** . More precisely, given a pair of random variables X,Y, we can write down the function $\mu(x)$ defined to be

$$\mu(x) := \mathbb{E}[Y \mid X = x].$$

In the Linear Regression unit, the assumption was that $\mu(x)$ was a linear function of x. For example, in the one-variable case, we assumed $\mu(x) = a + bx$; and for higher dimensions, $\mu(\mathbf{x}) = \mathbf{x}^T\beta$.

Discussion

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Topic: Unit 7 Generalized Linear Models:Lecture 21: Introduction to Generalized Linear Models; Exponential Families / 3. Review