1. Let $\hat{\beta}_0$ and $\hat{\beta}_1$ be, respectively, the ordinary least-square estimators for the parameters β_0 and β_1 in the linear model $Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i$, where $\varepsilon_i \sim \mathscr{N}(0, \sigma^2 I)$.

   Let $\hat{Y}_i$ and e_i be the fitted values and residuals of the fitted model, respectively. Please

   (1) show that the two estimators are unbiased estimators (10%)
   (2) derive the sampling distributions of the two estimators and $\hat{Y}_i$ (25%)
   (3) verify that $\Sigma X_i e_i = 0$ and $\Sigma \hat{Y}_i e_i = 0$ (5%)

2. An animal ecologist suggests three methods to prevent squirrels from damaging NTU Experimental Forest's *Cryptomeria* plantations. To determine the effectiveness of the three methods, a small experiment was conducted with 9 replications for each treatment (method). The **Treatment Total** of each method is listed below. MSE of the experiment was 60. Please construct a complete ANOVA table based on the above information. Please **state the null and alternative hypotheses**. The ANOVA table should include the following columns: SOV, DF, SS, MS, and F value. (20%)

	Method		
	I	II	III
Treatment Total	243	324	189

3. A researcher in NTU Experimental Forest conducted an experiment to test whether seedling of *Cryptomeria japonica* respond differently to four different N fertilizers. The experiment design was a CRD design with an equal replication of $n = 5$ for each treatment. The four **Treatment Means** are 43, 89, 67, 40. For the experiment, SSE = 72.00. Please **state the null and the alternative hypotheses**, and construct a complete ANOVA table. The ANOVA table should include the following columns: SOV, DF, SS, MS, and F value. (20%)

4. Please explain in hypothesis testing what Type I error, Type II error, the significance level of a test, the power of a test, and the power function of a test are. (20%)

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