Lesson 10

Ex. 2.7.1 **a)** $n \approx 120$
b) $n \approx 100$

Ex. 2.6.1 **a) Curvature is examined with** $v_{PQ} = 0.0056 \approx 0.01 << 39.86$**. No tendency to curvature.**
$SS_{PQ} = \frac{(\bar{y}_F - \bar{y}_C)^2}{\frac{1}{4}+\frac{1}{2}} = 0.02083$
$SS_E = (2-1) \cdot s_C^2 = 3.7538$**, where** s_C^2 **=sample standard deviation for measurements from center point.**
b) Since we did not find any tendency to curvature, it is not likely that (i) will be succesfull. We follow (ii) and move from $x_1 = 0$**,** $x_2 = 0$ **in direction** $(6.33, 3.10)$**.**

Ex. 2.7.2 $0.05 = 1 - \Phi\left(\frac{K-\frac{n}{2}}{\sqrt{n}/2}\right)$
$0.8 = 1 - \Phi\left(\frac{K-0.7n}{\sqrt{0.21n}}\right)$
gives $n = 37$**. Calculation using binomial distribution without approximation provide** $n = 37$**:** $K = 24$**,** $\alpha = 0.049$**, power** $= 0.807$**.**

Ex. I **a) The observed points follow the curved curve much better. The straight line in the first plot seems to be systematically wrong in relation to the observed values.**
b) $I_{\beta_2} = (\hat{\beta}_2 \pm t \cdot s \cdot \sqrt{h_{22}}) = (-7.11; -4.11)$**. We see that** $0 \notin I_{\beta_2}$**. Hence,** x^2 **is useful as an explanatory variable.**
c) For the estimated regression relationship $x = 10.21$ **is the value that gives highest reduction of the phosphate. This is only an estimate of the optimum** x**-value.**
d) $\hat{m}_{10} - \hat{m}_{11} = -\hat{\beta}_1 - 21\hat{\beta}_2 = 3.226$**. Hence, pH=10 seems to be better than pH=11.**

Ex. 2.6.2 **a)** $v_{PQ} = 125.8 > 18.51$**. There is, with high probability, curvature of the response surface, which means that there is an optimum point in that particular area.**
b) New measurements should be taken in $(-\sqrt{2}, 0)$**,** $(\sqrt{2}, 0)$**,** $(0, -\sqrt{2})$**,** $(0, \sqrt{2})$**. In addition, you should make additional measurements in the center point to get safer** σ^2**-estimator.**

Ex. 2.6.3 **Starting from zero (0,0) one should more in direction (2.1,-3.5), for example make new measurements of** y**-value in points (0.6,-1), (1.2, -2), (1.8, -3),** $\ldots$ **and continue so long the value** y **is increasing and both** x_1 **and** x_2 **remains within the acceptable range.**

Ex. 2.7.3 **at least 16 people.**

Ex. 2.7.4 **a) Significe level** $\alpha \approx 0.07$ **(using normal approximation)**
b) Power ≈ 0.993 **(using Poisson approximation)**