Rachunek prawdopodobieństwa i statystyka

Problem set №12. Week starting on May, 18th

1. The data includes the daily number of ads in newspapers A, B and C. We test the hypothesis: **the average number of ads in three newspapers is the same**.

2. Data: daily number of entries in four departments (A, B, C, D) of the company. Tested hypothesis: **the number of entries is on average the same in all departments**.

3. Consider recording the number of earthquakes in four observation points. Tested hypothesis is of the form: **points are located within the same geological structure**.

4. Data: strength of three types of tires from five manufacturers. Tested hypotheses: **average tire strength is independent of the manufacturer** and **different tire types have different durability**.

Ex. 5–8. Random variable $Y = \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix}$ is of $N(\mu, \Sigma)$ distribution, with parameters $\mu = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$ and $\Sigma = \begin{bmatrix} 4 & 1 \\ 1 & 9 \end{bmatrix}$. Let $U = \frac{1}{2\sqrt{15}}(-3Y_1 + 2Y_2)$ and $V = \frac{1}{2\sqrt{21}}(3Y_1 + 2Y_2 - 12)$.

5. (2 p.) Prove that $Z_1 = U^2 + V^2$. Z_1 like in exercise 8.

6. Check that random variables U, V are independent.

7. Check that $U, V \sim N(0, 1)$.

8. What is distribution of random variable $Z_1 = (Y - \mu)^T \Sigma^{-1} (Y - \mu)$?

9. Given data in file rp12-09.csv
   (a) find confidence interval with respect to mean (expected value), confidence level $\alpha = 0.05$,
   (b) find p-value.

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10. **(E3)** Data: factor A - normal (1) or higher level of sugar (2); factor B - normal weight (1) or above normal (2). The dependent variable is blood pressure. **is there a relationship between level of sugar and blood pressure**, **is there a relationship between weight and blood pressure**, and **is there any interaction between weight and sugar level**?

11. **(E2)** Factor A is an advertising medium, factor B is the main topic of advertising, data is a percentage of positive reactions to advertising. **Is there a relationship between the ad medium and the performance of the ad**, **which type of ad is most effective** and **is there a relationship between the theme of the ad and its media**?

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