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STATISTICS FOR EES AND MEME — EXERCISE SHEET 5

1. A casino offers the following game: One dice is rolled, and if X is the number of pips, then the player wins $f(X) = 3 - (x-3)^2$ Euros, where negative values of means $f(X)$ mean that the player loses money. Let $G = f(X)$ be the gain of a player in one game. Let T be the total gain of a player who played the game 100 times (where a negative gain is actually a loss).

(a) Calculate $\mathbb{E}G$ in two ways: once directly with the definition of the expectation value, and once with formula (a) from exercise 3 of exercise sheet 4.

(b) Calculate the expectation value and the standard deviation of T.

(c) Which well-known distribution is can be used to approximate the distribution of T?

2. A breeder crossed 200 pairs of plants of some crop. The yield of the father plant, the mother plant and the offspring (F1) is given in table yield.csv (in some measuring unit). For the next generation, the breeder crosses plants from the F1 generation, but selects for this only plants of a yield of more than 20.

(a) Visualize the distributions of the yield in the parent population, in the offspring population before selection and in the offspring population after selection.

(b) Add lines indicating the mean values to your plot.

(c) Predict the average yield of the plants of the F2 generation and show it in your plot.

3. A random variable Y with values in $\mathbb{N}_0 = \{0, 1, 2, 3, \ldots\}$ is Poisson distributed with parameter λ if

$$\Pr(Y = k) = \frac{\lambda^k}{k!} e^{-\lambda}.$$

If X is a binomially distributed random variable with Parameters (n, p) and $\lambda = n \cdot p$, the Poisson approximation says

$$\Pr(X \leq k) \approx \Pr(Y \leq k).$$

Explore for which combinations of n, p, and k the Poisson approximation is better than the normal approximation.