**Probability, homework 10, due December 6th.**


Some exercises are from *A first course in probability*, ninth edition, by Sheldon Ross.

**Exercise 1** A die is continually rolled until the total sum of all rolls exceeds 300. Approximate the probability that at least 80 rolls are necessary.

**Exercise 2** An insurance company has 10,000 automobile policyholders. The expected yearly claim per policyholder is 240 USD, with a standard deviation of 800 USD. Approximate the probability that the total yearly claim exceeds 2.7 million USD.

**Exercise 3** Suppose that a fair die is rolled 100 times. Let $X_i$ be the value obtained on the ith roll. Compute an approximation for

$$\mathbb{P}\left(\prod_{i=1}^{100} X_i \leq a^{100}\right), \quad 1 < a < 6.$$

**Exercise 4** Let the $X_\ell$'s be i.i.d. real random variables, uniform on $[0,1]$. What is the limit of $(X_1^3 + \cdots + X_n^3)/(X_1 + \cdots + X_n)$ as $n \to \infty$? In which sense?

**Exercise 5**. Let $(X_i)_{i \geq 1}$ be a sequence of independent random variables, with $X_i$ uniform on $[-i, i]$. Let $S_n = X_1 + \cdots + X_n$. Prove that $S_n/n^{3/2}$ converges in distribution and describe the limit.