Conditional probability & independence

This lecture introduces quite a few new concepts again: **joint probabilities**, **marginal probabilities** and subsequently also **conditional probabilities** and **independence between events or random variables**. Finally, the relationship between conditional probabilities in two directions, **Bayes' law**, is explained.

The probabilities that values of different variables co-occur are called joint probabilities. Such joint probabilities can be summed over one variable to form so-called marginal probabilities (the probabilities for a single variable). In the first video-lecture these concepts of joint and marginal probability are explained by using an example of beach-visitors which are characterized by gender and activity.

In the subsequent video the conditional probability is defined and clarified. Conditional probability is the probability of an event, given that another event occurs. In this lecture the example with beach-visitors is used again, but now to illustrate how probabilities of the activity distribution would f.i. change conditional on gender. Mathematically, the conditional probability of A given B equals the joint probability of A and B, divided by the (marginal)probability of event B.

The third video explains that independence of random events is closely related to the conditional probability between these events. It appears that random events are independent if the joint probability of these events is equal to the product of the marginal probabilities or, equivalent, if the conditional probability of random variable equals its marginal probability.

The fourth and final video of this module brings together joint and conditional probabilities as well as tree-diagrams to derive and intuitively explain Bayes' law. It shows how the observation that joint probabilities can be calculated based on the conditional probability of A given B as well as B given A, leads to Bayes' law. The last video lecture ends by explaining that while Bayes' follows mechanically by rewriting two probability-relations, it is often applied much more generally - by updating a prior belief in or knowledge about an hypothesis A with additional evidence B towards a posterior belief (A conditional on B).