

PSM Spring 2019, Exercise Sheet 2

Problem 1. If $X: \Omega \rightarrow \{1, 2\}$, $Y: \Omega \rightarrow \{m, f, o\}$, $Z: \Omega \rightarrow \{[0, 10], (10, 100]\}$, what is the size of the sample space of the RV $W = X \otimes Y \otimes Z$ (that is, how many elements does that sample space have)?

Problem 2 (a formalization exercise) Consider a handwriting recognition system which does the job illustrated in Fig. 1 in the lecture notes. The raw input to this system is a high-resolution grayscale photographic image of an entire page of some handwritten document. Assume that this raw input is delivered by a RV $X: \Omega \rightarrow$ <the set of all grayscale images of size 2000×1000 pixels>. In a preprocessing stage, from such raw input images small rectangular fields like the one shown in Figure 1 are cropped. In addition to mere cropping, an “area of interest” inside the crop window is identified by the preprocessor. The complement of this area of interest is indicated in Figure 1 by the dark gray background color. Formally, this preprocessor is a transformation operation π which acts on X , giving a new RV $Y = \pi \circ X$. Your task: give a *formal* specification of the sample spaces of X and Y (not using plain English but math formalism). Your formalization should take into account the area of interest.

Problem 3 (setting up a model for a super-complex temporal system) Global economists try to model **the global economy system** (of course, what else should they do) – just like meteorologists try to model the global atmospheric system. This is a temporal system of stunning complexity, and modeling it formally as a stochastic process is an extraordinarily difficult task. One difficulty is the heterogeneity of relevant information that has an impact on, or should even be considered part of, the global economical system. These relevant components not only comprise standard financial indicators but also factors like natural catastrophes, wars, elections, inventions... almost everything that happens on this planet.

Your task: Describe in English a suitable RSOI. (hint: think of the Weather Forecast example in the LN). Specifically, what are elementary events ω ?