



## Why

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### Definition

Let  $Z$  and  $X$  be sets, either of which may or may not be finite.

A *latent generation pair* from *latents*  $Z$  to *observations*  $X$  is an ordered pair  $(p_z, p_{x|z})$  whose first coordinate is a distribution (density) on  $Z$  and whose second coordinate is a conditional distribution (density) on  $X$  from  $Z$ .

The *joint function*  $p_{zx} : Z \times X \rightarrow \mathbf{R}$  of the pair is defined by  $p_{zx}(\zeta, \xi) = p_z(\zeta)p_{x|z}(\xi, \zeta)$  for all  $\xi \in X$  and  $\zeta \in Z$ . It is a distribution (density) if (not only if) both  $p_z$  and  $p_{x|z}$  are distributions (densities). Regardless, we define the *marginal function*  $p_x : X \rightarrow \mathbf{R}$  by  $p_x(\xi) = \int_Z p_{zx}(\xi, \cdot)$ . It too may be a distribution, density, or neither. In cases we construct, it is often one a distribution or a density, but it need not be either.

### Interpretation as distribution graph

The latent generation pairs from  $Z$  to  $X$  are isomorphic to the graph distributions whose typed graph  $(\{1, 2\}, \{(1, 2)\}), (Z, x)$ .<sup>2</sup>

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<sup>1</sup>Future editions will include.

<sup>2</sup>Future editions will include a visualization.

## Parametrizations

By parameterizing either or both of the coordinates of the pair, we have *latent generation family*.

## Other terminology

Other terminology for latent generation pair includes *latent variable model*. Some authorities refer to the marginal function as the *generative model*, still others use this term to refer to the pair.

