9. The first example: modelling assumptions

The kiss example: modelling assumptions

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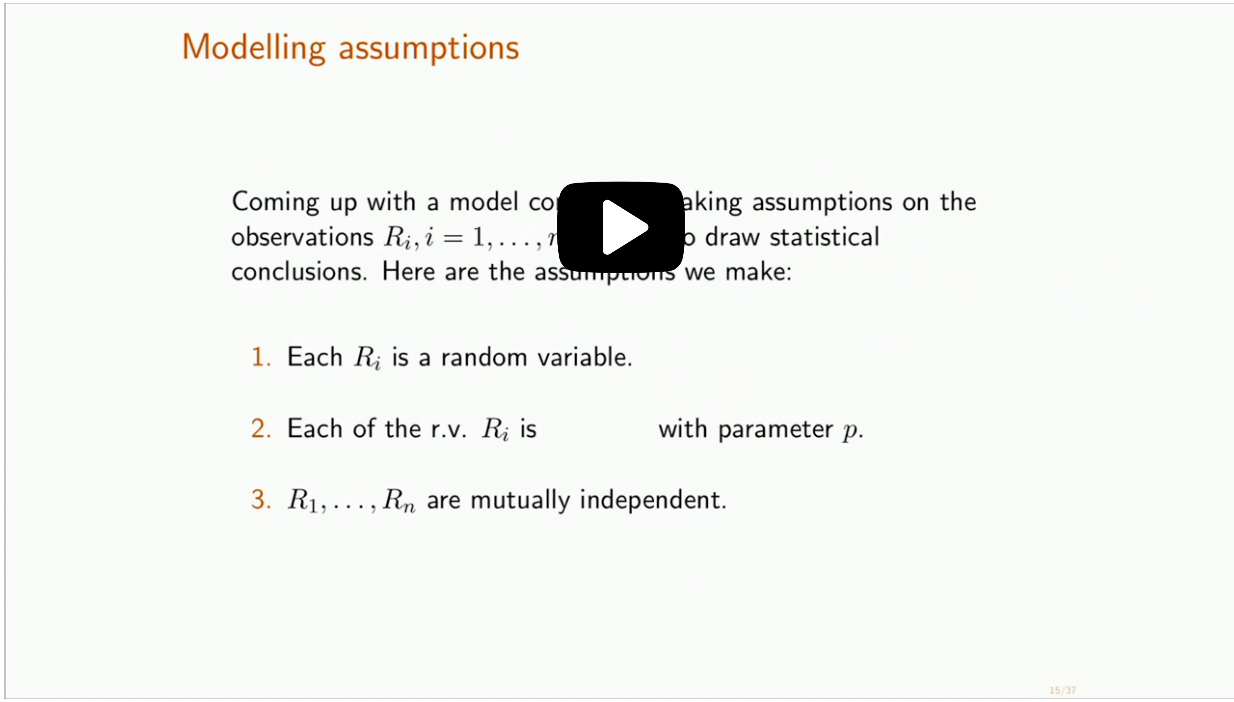

So here are the modeling assumptions.

Now I need to actually tell you what

those random variables are.

So coming up with a model is going

to be essentially making assumptions on what those

Ri's are.

So here are the assumptions that we made.

The first one is that each Ri is a random

0:00 / 0:00 1.50x

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Independence

1/1 point (graded)

Consider a probabilistic experiment where we roll a dice and toss a coin. We compute the probability that the fair dice gives 5 and the fair coin lands Heads. What assumptions are we implicitly using in this specific calculation: $\mathrm{Pr}\left(5,\mathrm{Heads}\right) = \mathrm{Pr}\left(5\right) \cdot \mathrm{Pr}\left(\mathrm{Heads}\right) = \frac{1}{6} \cdot \frac{1}{2}$? Choose all that apply, so that the chosen assumptions best capture the required concepts.

- [x] Each dice roll is uniformly distributed within the set $\{1,2,3,4,5,6\}$ and each coin toss is uniformly distributed in $\{\mathrm{Heads}, \mathrm{Tails}\}$.
- [x] The dice roll and coin toss are independent.
- [ ] The random variables corresponding to outputs of each of these experiments are i.i.d.

✔

Solution:

The correct answers are the first and second choices.

Let X denote the output of the dice roll and Y denote the output of the coin toss. We are looking at the probability

$$\begin{aligned} \mathbb{P}\left(X=5, Y=\{Heads\}\right) &= \mathbb{P}\left(X=5\right)\mathbb{P}\left(Y=\{Heads\}\right) \\ &= \frac{1}{6}\cdot\frac{1}{2}. \end{aligned}$$

The first line, where we express the joint probability as a product, uses the fact that coin toss and dice roll are independent. The second line, where we substitute the values $1/6$ and $1/2$, uses the uniformity assumption to explicitly compute these probabilities.

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Answers are displayed within the problem

(Optional) Examples of I. I. D. variables

0 points possible (ungraded)

Remember from the course *Probability–the Science of Uncertainty and Data* that **i.i.d.** stands for **independent and identically distributed** .

A collection of random variables $X_1, \ldots, X_n$ are **i.i.d.** if

1. each X_i follows a distribution $\mathbf{P}_i$, all those distributions $\mathbf{P}_i$ are the same, and
2. X_i are (mutually) independent

Decide which of the following collections are (approximately) i.i.d. (independent and identically distributed).
(Choose all that apply.)

- [x] People selected randomly (with replacement) by their address from a directory.

- [ ] The first two consecutive words of a random page in a book.
- [x] Repeated dice rolls of the same die.
- [ ] Temperature measurements on Monday and Tuesday in the same week.

Solution:

If we select people randomly from a base population, we are in charge of the sampling and can do so in an independent manner. Since the distribution is the same, this is a case of i.i.d. random variables. Note that if the population is large, the distribution of a small number of draws actually behaves similar to an i.i.d. draw, even if we sample without replacement.

Words in text documents are not independent because they follow certain compositional rules. For example, it is likely to find a noun preceded by an article.

If a dice is rolled repeatedly, we consider each roll an independent draw from the same distribution, hence this is an iid process.

Temperature measurements are highly correlated in time, although winter in Boston, where MIT is can sometimes make you think otherwise. Roughly speaking, if Monday has a warm weather, you would probably not expect Tuesday to be freezing cold.

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Answers are displayed within the problem

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[STAFF] Is the given solution of Independence exercice correct?
If the dice roll distribution is P(X=5)=1/6 P(X=4)=5/6 P(X=1)=0 P(X=2)=0 P(X=3)=0 P(X=6)=0 the specific calculation P(X=5, Y= Head)= 1/2*1/6 is still valid,... 12

Any recommendations on resources for exploring modelling when variables are dependent?
This is something which has interested me (only as a thought process because I have never taken a statistics class before), so wondering if anyone h... 3

Selecting by the address
Wouldn't selecting people by their address generate a bias? People living in large buildings (many people for the same address) would have fewer ch... 7

About "Temperature measurements on Monday and Tuesday in the same week."
I live in Quito and have a QUITE different opinion about checkbox 4. 2

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