Natural Computing, Assignment 3

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Combining, Bagging & Random Forests

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(a)

- The probability that all three doctors give the correct answer is $0.8^3 = 0.512$.
- The probability that exactly 2 doctors make the right call is $0.8 * 0.8 * 0.2 + 0.8 * 0.2 * 0.8 + 0.2 * 0.8 * 0.8 = 0.384$. Therefore, the probability that *at least* two doctors make the right call is $0.512 + 0.384 = 0.896$.
- The probability that this group makes the right decision based on majority voting is $0.512 + 0.384 = 0.896$ since the majority is when there are at least two individuals.

(b)

The general formula is

$$P(\text{correct predictions} > c/2) \sum_{i=\lfloor n/2 \rfloor}^{n} p^i (1-p)^{n-i} \binom{n}{i}.$$

Using this formula, we find a probability of about 0.826.

(c)

If we use 10000 runs of the simulations, we get an approximately equal result of 0.826. Writing out more decimals gives us a difference of 0.0057. So our approximation is pretty good.

(d)

We decided to use a surfplot for the visualization. Here we can easily spot the differences when variables change relative to each other.

The surfplot can be found in figure 1. What we can observe from this plot is that the jury size matters for a low number of people, but that this effect has exponentially diminishing returns. The competence, as expected, has the highest effect on the probability of correctly making the right decision.

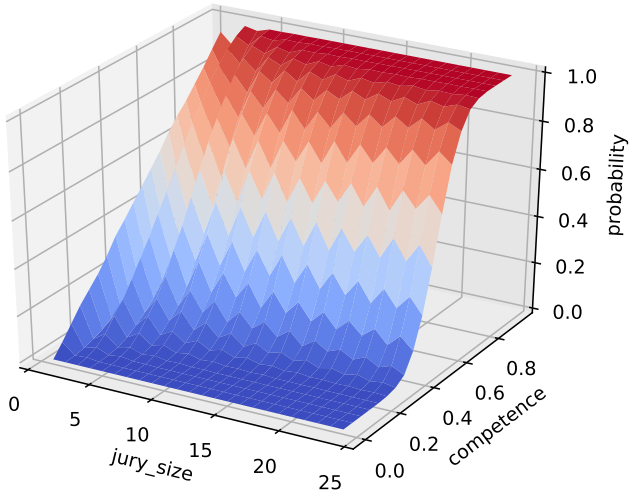

Figure 1: Surfplot of the probabilities as a function of the jury size c and competence p.

(e)

The probabilities for making the correct decision for the groups are:

- **radiologists**: 0.850
- **doctors**: 0.896
- **students**: 0.826

To reach the same probability for making the correct decision as the group of doctors, using only students. You would need 28 students. These would, collectively, have a probability of making the correct decision of 0.898.

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Boosting

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