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14/05/2020

LESSON 8: Python Probability Practice

i. Simulating coin flips

```
→ import numpy as np
  import matplotlib.pyplot as plt
  % matplotlib inline

→ # outcome of one coin flip
  np.random.randint(2)
    ↳ 0

→ # outcomes of ten thousand coin flips
  np.random.randint(2, size=10000)
    ↳ array([0,1, ..., 0,0])

→ # mean outcome of ten thousand coin flips.
  np.random.randint(2, size=10000).mean()

→ # outcome of one coin flip
  np.random.choice([0,1])
    ↳ 0

→ # outcome of ten thousand coin flips
  np.random.choice([0,1], size=10000)
    ↳ array([1,1,0,1 ... ,1,0,1])

→ # mean outcome of ten thousand coin flips
  np.random.choice([0,1], size=10000).mean()
    ↳ 0.4924
```

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→ # outcomes of ten thousand biased coin flips
np.random.choice([0,1], size=10000, p=[0.8,0.2])
↳ array([0,0,...,1,0,0])

→ # mean outcomes of ten thousand biased coin flips
np.random.choice([0,1], size=10000, p=[0.8,0.2]).mean()
↳ 0.2053

→ Conditional Probability & Bayes rule Quiz

P(cancer) = 0.105
P(¬cancer) = 0.895
P(Positive|cancer) = 0.905
P(Negative|cancer) = 0.095
P(positive|¬cancer) = 0.204
P(negative|¬cancer) = 0.796

a) P(cancer|positive)

$$P(\text{cancer}|\text{positive}) = \frac{P(\text{Positive}|\text{cancer})\ P(\text{cancer})}{P(\text{Positive})}$$

$$P(\text{Positive}) = P(\text{cancer}).P(\text{Positive}|\text{cancer}) + P(\neg\text{cancer}) P(\text{Positive}|\neg\text{cancer})$$

$$= 0.105 \times 0.905 + 0.895 \times 0.204$$

$$= \cancel{0.1019059} \ 0.277605$$

$$P(\text{cancer}|\text{Positive}) = \frac{0.905 \times 0.105}{0.277605}$$

$$= 0.3422$$

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b) $P(\neg cancer | Positive)$

$$P(\neg cancer | Positive) = \frac{P(\neg cancer)\ P(Positive | \neg cancer)}{P(Positive)}$$

$$= \frac{0.895 \times 0.204}{0.277605}$$

$$= 0.658$$

c) $P(cancer | Negative)$

$$P(Negative) = P(cancer) \times P(Negative | cancer) + P(\neg cancer) \times P(Negative | \neg cancer)$$

$$= 0.105 \times 0.098 + 0.895 \times 0.796$$

$$= 0.741$$

$$P(cancer | Negative) = \frac{P(Negative | cancer)\ P(cancer)}{P(Negative)}$$

$$= \frac{0.095 \times 0.105}{0.741}$$

d) $P(\neg cancer | Negative)$

$$P(\neg cancer | Negative) = \frac{P(Negative | \neg cancer) \cdot P(\neg cancer)}{P(Negative)}$$

$$= \frac{0.796 \times 0.895}{0.741}$$

$$= 0.9614$$

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