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CS 583-01

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CS 583 – Assignment 4

1. We have three variables: X, Y, and Z. X and Z are binary with domain {T, F} and Y has three possible values: {R, G, B}. The Bayesian network has the following structure: . Here are the counts for a dataset D. If a count is zero, it is not listed.

A grid of black and white squares

Description automatically generated  
Note that we need to estimate and for this network.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| P(X) | Counts | P(X) = Counts / 150 | | P(Xnext | D) | | P(Xnext | D) | |
| T | 60 | 60/150 = 6/15 = 2/5 | 0.4 | 61/152 | 0.40132 | 66/162 | 0.40741 |
| F | 90 | 90/150 = 9/15 = 3/5 | 0.6 | 91/152 | 0.59868 | 96/162 | 0.59259 |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| P(Y|X = T) | Counts | P(X) = Counts / 60 | | P(Xnext | D) | | P(Xnext | D) | |
| R | 30 | 30/60 = 3/6 = 1/2 | 0.5 | 31/63 | 0.49206 | 32/66 | 0.48485 |
| G | 0 | 0 | 0 | 1/63 | 0.01587 | 2/66 | 0.03030 |
| B | 30 | 30/60 = 3/6 = 1/2 | 0.5 | 31/63 | 0.49206 | 32/66 | 0.48485 |
| P(Y|X = F) | Counts | P(X) = Counts / 90 | | P(Xnext | D) | | P(Xnext | D) | |
| R | 40 | 40/90 = 4/9 | 0.444 | 41/93 | 0.44086 | 42/96 | 0.43750 |
| G | 0 | 0 | 0 | 1/93 | 0.01075 | 2/96 | 0.02083 |
| B | 50 | 50/90 = 5/9 | 0.556 | 50/93 | 0.53763 | 52/96 | 0.54167 |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| P(Z|Y = R) | Counts | P(X) = Counts / 70 | | P(Xnext | D) | | P(Xnext | D) | |
| T | 10 | 10/70 = 1/7 | 0.14286 | 11/72 | 0.15278 | 12/74 | 0.16216 |
| F | 60 | 60/70 = 6/7 | 0.85714 | 61/72 | 0.84722 | 62/74 | 0.83784 |
| P(Z|Y = G) | Counts | P(X) = Counts / 0 | | P(Xnext | D) | | P(Xnext | D) | |
| T | 0 | 0 | 0 | 1/2 | 0.5 | 2/4 | 0.5 |
| F | 0 | 0 | 0 | 1/2 | 0.5 | 2/4 | 0.5 |
| P(Z|Y = B) | Counts | P(X) = Counts / 80 | | P(Xnext | D) | | P(Xnext | D) | |
| T | 80 | 80/80 | 1.00000 | 81/82 | 0.98780 | 82/84 | 0.97619 |
| F | 0 | 0 | 0 | 1/82 | 0.01220 | 2/84 | 0.02381 |

* 1. What are the MLE estimates?
  2. Assuming a uniform prior and K2 approach to Bayesian estimation, what are the predictive for next X, Y|X, and Z|Y?
  3. Assuming a |D`| = probabilities 12 and P` is uniform, and a BDE approach to estimation, what are the predictive probabilities for next X, Y|X, and Z|Y?