Figure 13.9 A Bayesian network for evaluating car insurance applications.

causal structure of the domain and gives an accurate, well-calibrated distribution over the output variables given the evidence available from the application form.[3] The Bayes net will include **hidden variables** that are neither input nor output variables, but are essential for structuring the network so that it is reasonably sparse with a manageable number of parameters. The hidden variables are shaded brown in Figure 13.9.

Hidden variable

The claims to be paid out—shaded lavender in Figure 13.9—are of three kinds: the *MedicalCost* for any injuries sustained by the applicant; the *LiabilityCost* for lawsuits filed by other parties against the applicant and the company; and the *PropertyCost* for vehicle damage to either party and vehicle loss by theft. The application form asks for the following input information (the light blue nodes in Figure 13.9):

- About the applicant: *Age*; *YearsLicensed*—how long since a driving license was first obtained; *DrivingRecord*—some summary, perhaps based on "points," of recent accidents and traffic violations; and (for students) a *GoodStudent* indicator for a grade-point average of 3.0 (B) on a 4-point scale.

- About the vehicle: the *MakeModel* and *VehicleYear*; whether it has an *Airbag*; and some summary of *SafetyFeatures* such as anti-lock braking and collision warning.

- About the driving situation: the annual *Mileage* driven and how securely the vehicle is *Garaged*, if at all.

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3   The network shown in Figure 13.9 is not in actual use, but its structure has been vetted with insurance experts. In practice, the information requested on application forms varies by company and jurisdiction—for example, some ask for *Gender*—and the model could certainly be made more detailed and sophisticated.