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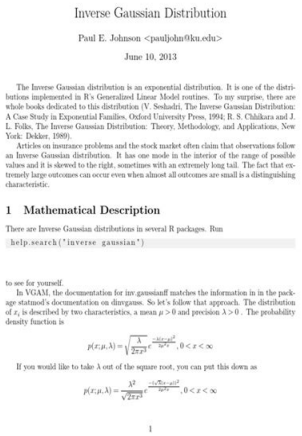

Inverse Gaussian Distribution

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The Inverse Gaussian distribution is an exponential distribution. It is one of the distributions implemented in R's Generalized Linear Model routines. To my surprise, there are whole books dedicated to this distribution (V. Seshadri, The Inverse Gaussian Distribution: A Case Study in Exponential Families, Oxford University Press, 1994; R. S. Chhikara and J. L. Folks, The Inverse Gaussian Distribution: Theory, Methodology, and Applications, New York: Dekker, 1989).

Articles on insurance problems and the stock market often claim that observations follow an Inverse Gaussian distribution. It has one mode in the interior of the range of possible values and it is skewed to the right, sometimes with an extremely long tail. The fact that extremely large outcomes can occur even when almost all outcomes are small is a distinguishing characteristic.

1 Mathematical Description

There are Inverse Gaussian distributions in several R packages. Run

```
help.search("inverse gaussian")
```

to see for yourself.

In VGAM, the documentation for inv.gaussianff matches the information in in the package statmod's documentation on dinvgauss. So let's follow that approach. The distribution of x_i is described by two characteristics, a mean $\mu > 0$ and precision $\lambda > 0$. The probability density function is

$$p(x;\mu,\lambda) = \sqrt{\frac{\lambda}{2\pi x^3}} e^{\frac{-\lambda(x-\mu)^2}{2\mu^2 x}}, 0 < x < \infty$$

If you would like to take λ out of the square root, you can put this down as

$$p(x;\mu,\lambda) = \frac{\lambda^2}{\sqrt{2\pi x^3}} e^{\frac{-(\sqrt{\lambda}x-\mu)^2}{2\mu^2 x}}, 0 < x < \infty$$

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