Property tests for squiggle

Here are some property tests for squiggle. I am testing mostly for the mean and the standard deviation. I know that squiggle doesn't yet have functions for the standard deviation, but they could be added.

The keywords to search for are "algebra of random variables".

Sums

$$mean(f + g) = mean(f) + mean(g)$$

$$Std(f + g) = sqrt(std(f)^2 + std(g)^2)$$

In the case of normal distributions,

$$normal(a, b) + normal(c, d) = normal(a + c, sqrt(b^2 + d^2))$$

Substractions

$$mean(f - g) = mean(f) - mean(g)$$

$$std(f - g) = sqrt(std(f)^2 + std(g)^2)$$

Multiplications

$$mean(f \cdot g) = mean(f) \cdot mean(g)$$

$$std(f{\cdot}g) = sqrt((std(f)^2+mean(f)){\cdot}(std(g)^2+mean(g))-(mean(f){\cdot}mean(y))^2)$$

Divisions

Divisions are tricky, and in general we don't have good expressions to characterize properties of ratios. In particular, the ratio of two normals is a Cauchy distribution, which doesn't have to have a mean.

To do:

- Provide sources or derivations, useful as this document becomes more complicated
- Provide definitions for the probability density function, exponential, inverse, log, etc.
- Provide at least some tests for division

- See if playing around with characteristic functions turns out anything useful