Re: Testing for product of Gaussians

Source: http://sci.tech−archive.net/Archive/sci.math/2005−04/msg02752.html

- *From*: hrubin@xxxxxxxxxxxxxxxxxxx (Herman Rubin)

- *Date*: 18 Apr 2005 13:41:16 −0500

In article <1113845114.927536.38970@xxxxxxxxxxxxxxxxxxxxxxxxxxxx>,
<newsquestions2003@xxxxxxxxx> wrote:
>Hi

>I am posting to sci.math as my original message (under a different
>title) in sci.stat.math was ignored − the two stat newsgroups don't
>seem as busy as this one. Sorry if this is considered off topic over
>here.

>I'd like to know an appropriate statistical test for finding out
>whether data in 2 dimensions comes from the product of two uncorrelated
>normal distributions. To be more specific for a series of (x,y) pairs
>I have a value (let's say z) created by a computer simulation. I know
>the actual values of z should be drawn from the product of two
>independent normal distributions with mean zero and the same standard
>deviation in both directions. I wonder if anyone could tell me an
>appropriate statistical test to check that computed values have indeed
>probably come from this underlying distribution? Given that so many
>parametric tests seem to require normal data to work properly, I'd
>guess this is a very standard question?

If you know the standard deviations, a Kolmogorov−Smirnov
test against the computed Bessel function distribution will
work. If you do not, there is a scale parameter to fit, and
the distribution of this seems only obtainable by simulation.

>I have a reasonable mathematical background (although sadly I don't
>know very much statistics), so a reference to why the test works would
>be fantastic too. Looking on the internet I came up with a variety of
>possibilities, but thought it better to ask someone who knows before
>blindly applying a big formula!

The Kolmogorov−Smirnov test against a known continuous
distribution is distribution−free, which is why I was
able to come up with one so quickly.

>(In case it is relevant or helps explain what the statistical test I
>require more exactly, I am attempting to test a numerical solution the
>simple spatially homogeneous diffusion equation in 2 dimensions with

>delta function initial data. The numerical solution proceeds by
>creating a large number of individual particles at the origin and
>simulating each one randomly moving in space for a large number of time
>steps, with an appropriate step length based on the time step and the
>diffusion coefficient. Then at the end of the simulation the program
>counts the number of particles in each square on the plane for squares
>with small side lengths. I know the answer to the diffusion equation,
>so given the number of particles originally released can trivially find
>out how many particles I would expect to be in each square given its
>position. The simulation appears to give the correct answer, inasmuch
>as I get a nice bell shaped surface, but I'd like to be statistically
>sure. Before anyone numerically minded raises any objections, I know
>this is a terribly inefficient way of solving a diffusion equation, but
>I am later going to have to solve a reaction advection diffusion
>equation in some horrible geometry with strongly spatially varying
>advection so this Lagrangian style approach is a contender)

>Many thanks in advance to anyone who can help

What will be tested by any test whatever is the degree
of approximation by the discretization and the degree
of "randomness" of the numbers used to simulate.

Another way of testing this would be to test the two
coordinates separately for normality, and the pair for
independence. This is a stronger test.

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This address is for information only. I do not claim that these views
are those of the Statistics Department or of Purdue University.
Herman Rubin, Department of Statistics, Purdue University
hrubin@xxxxxxxxxxxxxx Phone: (765)494−6054 FAX: (765)494−0558
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- ***Follow−Ups***:
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- ◊ *From:* newsquestions2003

- ***References***:
  - ♦ ***Testing for product of Gaussians***
    - ◊ *From:* newsquestions2003

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