Sudoku Players' Forums

THE REAL DISTRIBUTION OF MINIMAL PUZZLES

Goto page Previous 1, 2, 3 ... , 22, 23, 24 Next

newtopic postreply **Sudoku Players' Forums Forum Index -> General/puzzle**

View previous topic :: View next topic

Author	Message
denis_berthier Joined: 19 Jun 2007 Posts: 842 Location: Paris, France	Posted: Fri Sep 25, 2009 11:43 pm Post subject: quote **Red Ed wrote:** Can you quantify the confidence that you now have in your estimate of the mean number of clues? **denis_berthier wrote:** No more than you can with your method. I just observe that, as the sample grows, the estimated unbiased mean doesn't change significantly. ... it would be good to quantify the confidence/uncertainty. Why not try bootstrap resampling. Good idea. Do you have any software that can do it? Back to top profile pm www
Red Ed Joined: 06 Jun 2005 Posts: 740	Posted: Fri Sep 25, 2009 11:48 pm Post subject: quote I use *R*. Leave it with me ... I've got a cunning plan ... Back to top profile pm
denis_berthier Joined: 19 Jun 2007 Posts: 842 Location: Paris, France	Posted: Sat Sep 26, 2009 12:23 am Post subject: quote **Red Ed wrote:** I use *R*. Leave it with me ... I've got a cunning plan ... I've been using Sage for other purposes. It is supposed to include R. But I've never seen much statistics in it. OK, I leave it to you.

hmm. "Cunning" in what sense?

cunning adjective (CLEVER)
/ˈkʌn.ɪŋ/
describes people who are clever at planning something so that they get what they want, especially by tricking other people, or things that are cleverly made for a particular purpose
a cunning plan/ploy

cunning adjective (ATTRACTIVE)
/ˈkʌn.ɪŋ/
US old-fashioned attractive; cute

(from http://dictionary.cambridge.org)

Back to top profile pm www

Red Ed

Posted: Sat Sep 26, 2009 12:33 am Post subject: quote

Joined: 06 Jun 2005
Posts: 740

The plan is actually just to let M(n) = random variable equal to the mean of n samples from the gamma distribution I mentioned a while back, then do two things: (1) plot the distribution of M(250000) ... I assume it's going to be Normal, but I'd like to check; (2) define V(n) = empirical estimate of the variance of M(n) and plot a graph of V(n) against n. Then, no matter how many trials you go on to do, we should be able to generate pretty reasonable confidence intervals around the mean with essentially no further work.

But chores first; fun later.

Back to top profile pm

eleven

Posted: Sat Sep 26, 2009 1:46 am Post subject: quote

Joined: 10 Feb 2008
Posts: 495

Red Ed wrote:

> But the real reason not to generate solution grids that way is that a lookup into the huge table that gsf has got would be more costly than using the B2347 algorithm mentioned earlier for unbiased generation.

In practice i would not need any lookup, but just read the grids one by one. When i am through, i have about 20000 puzzles with little bias. I think, there cant be a faster way to get the grids input.

Back to top profile pm

Red Ed

Posted: Sat Sep 26, 2009 1:50 am Post subject: quote

Joined: 06 Jun 2005
Posts: 740

Is this a philosophical line of enquiry or are you planning a particular experiment?

Back to top profile pm

eleven

Posted: Sat Sep 26, 2009 2:00 am Post subject: quote

I dont understand, it was a statement.

Joined: 10 Feb 2008
Posts: 495

Back to top profile pm

denis_berthier Posted: Sat Sep 26, 2009 2:44 am Post subject: quote

I don't know if eleven was planning an experiment, but it'd be an interesting one to try gsf's source of complete grids instead of suexg's in the controlled-bias generator.
The question is, is gsf's list available?

Joined: 19 Jun 2007
Posts: 842
Location: Paris, France

Back to top profile pm www

eleven Posted: Sat Sep 26, 2009 2:49 am Post subject: quote

If i remember right, you can produce it yourself with his program or he can send it to you on a memory stick.

Joined: 10 Feb 2008
Posts: 495

Back to top profile pm

denis_berthier Posted: Sat Sep 26, 2009 3:08 am Post subject: quote

Eleven,
If gsf's list was available, would there be a simple way of using it as a grid source for suexg-cb?
You speak of obtaining 20000 puzzles without bias. Do you mean with suexg-cb, considering that each minimal puzzle consumes ~ 225000 complete grids?

If we can do something like this, it may be worth contacting gsf. I've never been able to run his program (only for Windows, I think) on my Mac. I'm sure we can find a less mediaeval way of exchanging data than a memory stick.

Joined: 19 Jun 2007
Posts: 842
Location: Paris, France

Back to top profile pm www

denis_berthier Posted: Sat Sep 26, 2009 3:14 am Post subject: quote

> **Red Ed wrote:**
> The plan is actually just to let M(n) = random variable equal to the mean of n samples from the gamma distribution I mentioned a while back, ...

There was a problem with this gamma distribution: its mean didn't coincide with the mean of the sample. Annoying if you want to a compute a confidence interval for the mean.

Back to top profile pm www

eleven

Joined: 10 Feb 2008
Posts: 495

Posted: Sat Sep 26, 2009 3:20 am Post subject: quote

I dont have any experience with 64bit computers. In the best case it is enough to add the name of the file with all grids (uncompressed) on the sudogen command line.

See this link, the compressed grids have about 5.7 GB (and the generation takes about 2 weeks on 2GH).

I am sure that gsf will read this and can help you.

Back to top profile pm

Red Ed

Joined: 06 Jun 2005
Posts: 740

Posted: Sat Sep 26, 2009 8:26 am Post subject: quote

> **denis_berthier wrote:**
>
> > **Red Ed wrote:**
> >
> > > The plan is actually just to let M(n) = random variable equal to the mean of n samples from the gamma distribution I mentioned a while back, ...
> >
> > There was a problem with this gamma distribution: its mean didn't coincide with the mean of the sample. Annoying if you want to a compute a confidence interval for the mean.

It was just a typo: I meant the "corrected" mean. The maths is sound even if the explanation wasn't.

Back to top profile pm

Red Ed

Joined: 06 Jun 2005
Posts: 740

Posted: Sat Sep 26, 2009 12:34 pm Post subject: quote

The results of the experiments were that:

1. The distribution of the estimator of the true mean is pretty much Normal, in the sense that on a Normal QQ plot you get a straight line with the usual fuzziness at the ends.
2. The standard deviation is about 1.92/sqrt(N) where N is the total number of minimal puzzles produced.

So if M is the corrected estimate of the true (underlying) mean number of clues, calculated over N puzzles, generated by suexg-cb then confidence intervals can be claimed as follows:

- 90% confidence: M - 3.16/sqrt(N) < true mean < M + 3.16/sqrt(N)
- 95% confidence: M - 3.76/sqrt(N) < true mean < M + 3.76/sqrt(N)
- 98% confidence: M - 4.47/sqrt(N) < true mean < M + 4.47/sqrt(N)
- 99% confidence: M - 4.95/sqrt(N) < true mean < M + 4.95/sqrt(N)

and I would guess when evaluated to actual numbers that these are accurate to +/-1 in the second significant digit.

All of this is based on the assumption that gamma(524,0.0489) - or something

similar - is a good fit around the most important clue counts. I've not thought too hard about what "something similar" means; I think we can be fairly relaxed about exactly what the distribution is.

Back to top profile pm

Red Ed

Posted: Sun Sep 27, 2009 12:06 am Post subject: quote

Joined: 06 Jun 2005
Posts: 740

Applying the theory above to the current 250K sample gives the following confidence intervals for the true (underlying) mean number of clues:

- 90% : 26.56053 < true mean < 26.57319
- 95% : 26.55932 < true mean < 26.57440
- 98% : 26.55791 < true mean < 26.57581
- 99% : 26.55695 < true mean < 26.57677

The gamma distribution used for this had shape 524.8004 and scale 0.0488764. The observed and expected counts based on that distribution are shown below.

Code:

```
19        0        0.0000587
20        2        0.0357
21        3        5.83
22      323      290
23     4953     4892
24    30359    30588
25    77083    76969
26    83714    83718
27    41986    41933
28    10219    10234
29     1289     1280
30       68       85.8
31        1        3.22
32        0        0.0698
```

It can be seen that although the gamma distribution is a good fit, it is a little too heavy tailed. So next I'll try bootstrap resampling, to see what CIs that gives. (The only reason not to have done that *first* is that it has to be repeated for every new sample, whereas fitting a distribution can be done just once.)

EDIT: ran out of time to do this today.

Back to top profile pm

Display posts from previous: All Posts Oldest First Go

newtopic postreply **Sudoku Players' Forums Forum Index -> General/puzzle**

All times are GMT - 8 Hours
Goto page Previous 1, 2, 3 ... , 22, 23, 24 Next

Page 23 of 24

Jump to: General/puzzle Go

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