FIN285a: Computer Simulations and Risk Management
Midterm Exam: Wednesday, October 26th.
Fall 2011
Professor B. LeBaron

Directions: Answer all questions. You have 1 hour and 30 minutes. Point weightings are listed next to each problem. There are 100 points total. Answer what you know first, and then go back to other problems. Stay calm, and good luck.

Part I: Interpreting matlab code: In the following problems you will be asked to interpret some example matlab programs.

1. (3 points each part) What is the output of the following matlab programs:

a.)
```
x = sum( 2.^(1:3) )
```

```
14
```

b.)
```
y = [1:2:5];
mean(y)
```

```
3
```

c.)
```
prod( log(exp(1:3)))
```

```
6
```

d.)
```
(1:3)./(3:-1:1)
```

```
[0.33 1 3]
```

2. (15 points) For this problem, consider the following matlab code

```
p = dow(:,2);
ret1 = (p(2:end)-p(1:end-1)) ./ p(1:end-1);
v1 = var(ret1(end-99:end));
hh = 100000;
vdist = zeros(hh,1);
for i = 1: hh
    vdist(i) = var( sample(ret1,100));
end
proportion(vdist>v1)
```

a.) What type of returns are estimated in ret1? Do these correspond to the entire sample?

Arithmetic, Yes

b.) Is this a bootstrap or a monte-carlo experiment?

Bootstrap

c.) What is the last number printing?

Fraction of bootstrapped(sample=100) variances > last 100 day variance

d.) What is the null hypothesis being tested?

Last 100 day variance is the same as the entire sample.

e.) If it prints out 0.02, would you be able to reject the null hypothesis at the 5 percent level?

Yes.

3. (12 points) For this problem, consider the following matlab code.

```
% p = daily price of gold
ret1 = p(2:end)./p(1:end-1)-1;
pos  = (ret1>0); n = length(ret1);
count = 0;
for i=1:n-4
    if ( all(pos(i:i+4)==0) )
          count = count+1;
    end
end
prob = count/(n-4);
psim = zeros(10000,1); index = 1:n-4;
for i = 1:10000
    count = 0;
    for j = 1:n-4
       ii = sample(index,1);
       count = all(pos(ii:ii+4)==0);
    end
    psim(i) = count/(n-4);
end
s = std(psim);
[ prob - 1.96*s prob prob + 1.96*s ]
```

a.) What is prob estimating?

Probability of 5 days in a row of increasing gold price.

b.) What is the last line printing out?

sample estimate and 95% confidence band (assuming estimate is normally distributed)

c.) Does this simulation assume that the returns are independent? What type of sampling is it using that gives you your answer to this question?

No, this is a blocked bootstrap.

d.) Does this simulation assume that the returns are normally distributed?

No.

4. (15 points)For this problem, consider the following matlab code.

```
load ../data/dow.dat
p = dow(:,2);
ret1 = p(2:end)./p(1:end-1)-1;
nsamp = length(ret1);
z = std(ret1);
s = z;
y = mean(ret1);
rr = norminv(0.01,y,z);
v1 = -100 * rr;
zz = -s * normpdf(rr/s)/0.01;
mm = normal(100000,y,z^2);
rr1 = quantile(mm,0.01);
rr2 = mean( mm(mm <= rr1));
rr3 = -100*rr2;
for i = 1:1000
    mm = normal(nsamp,y,z^2);
    rb = quantile(mm,0.01);
    rb2 = mean( mm(mm <= rb) );
    w(i) = -100*rb2;
end
rr3
[quantile(w,[0.025, 0.975])]
```

a.) What is zz estimating?

E(R| R<=VaR)

b.) What is rr3 estimating?

Expected shortfall (0.01)

c.) Do either or both assume normality for returns (ret1)?
Both

d.) What is the simulation printing on the last line?

95% confidence interval, percentile method

e.) What is the starting (today's) value of the portfolio?
100

Part II. Multiple choice (2 points each): Circle the one best answer from the choices.

5. If 1 day continuously compounded returns are normally distributed then 2 day continuously compounded returns follow
>a.) a normal distribution.
b.) a student-t distribution.
c.) a Frechet distribution.
d.) not enough information

6. For the Jarque-Bera test the null hypothesis is
a.) a student-t distibution.
>b.) a normal distribution.
c.) a Frechet distribution.
d.) any distribution with finite variance.

7. If you type "normcdf(0,4,10)" into matlab, it will print
a.) 0.5
b.) 1.0
c.) 40
>d.) some complicated decimal number

8. The kurtosis of a student-t distribution with 5 degrees of freedom is
>a.) larger than a normal distribution
b.) smaller than a normal distribution
c.) the same as a normal distribution
d.) undefined

9. A good use for a QQ plot is to
a.) see if a variance is greater than the mean for a given sample.
b.) see if VaR is negative.
c.) see how many bootstraps need to be done.
>d.) check if a distribution is normal.

10. One fact about returns we talked about was that the exceedance correlation
>a.) is larger in the left tail of the distribution.
b.) is constant across return distributions.
c.) is always negative.
d.) is often undefined.

11. The measurement error in Value-at-Risk, due to sampling variation should be greatest for
a.) p = 0.10
b.) p = 0.05
c.) p = 0.01
>d.) p = 0.001

12. Which of the following is a problem for delta-normal VaR?
a.) returns are not normally distributed
b.) portfolio valuations may be nonlinear
c.) means and standard deviations are estimated with error
>d.) all of the above

13. VaR can be used as a
a.) benchmark comparison.
b.) potential loss measure.
c.) method to set capital cushion levels (reserves).
>d.) all of the above

14. One strength that Finger talks about for historical simulation in his article "How historical simulation made me lazy" is that
a.) it is **completely** assumption free.
>b.) it connects real events to extreme portfolio moves.
c.) it is subadditive.
d.) it can be easily manipulated by dishonest people.

15. In the class example of testing mushrooms and toadstools the unfortunate case of accepting (and eating) a poison toadstool was an example of
a.) type I error
>b.) type II error
c.) type III error
d.) p-values

16. Value-at-Risk was first used
>a.) on FX trading desks in the late 1980's.
b.) for agricultural futures markets in the 1960's.
c.) with residential mortgages in the early 21 century.
c.) by Pythagoras to evaluate Greek debt risk.

Part III. Very short answer. Answer the following with numbers or a few words.

17.) (6 points) A portfolio profit and loss values follow the following discrete distribution.

Value	Probability
-100	0.01
-50	0.02
-5	0.05
0	0.10
10	0.82

What is the VaR for p = 0.01, 0.05, and 0.10?

VaR(0.01) = 100, VaR(0.05) = 5, VaR(0.10) = 0

18.) (5 points) Y = aX + b, and the variance of X = 2, and a = 3. What is the variance of Y? (You might not have enough information to do this.)

var(Y)= a^2var(X) = 9*2 = 18

19. (5 points) If X and Y both have power-law tails for extreme negative values given by the following matlab equation,

```
p = A*abs(x)^(-alpha);
```

Write down a matlab expression (if you can) for the tail probability for X+Y.

P = B*abs(x) ^(-alpha);
Actually, B = A+A = 2A, but you didn't need to say this.

20.(6 points) Most of our results have shown that stock returns are not independent over time (this was also one of our key stylized facts for financial data). What feature in stock returns is clearly NOT independent over time? (You can answer this with one word if you want.)

Persistent or changing : Volatility, Variance, Standard deviation