NAME:

FIN285a: Computer Simulations and Risk Assessment
Final Exam: Wednesday, December 15th
Fall 2011
Professor B. LeBaron

Directions: Answer all questions. You have 3 hours. (However, you may finish early.) 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.

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

1. (4 points each part) What is the output of the following matlab programs:

a.)
```
mean( [1 1; 2 4])
```

[1.5 2.5]

b.)
```
cumprod([ 1 1 0 1])
```

[1 1 0 0]

c.)
```
x = [ 1 2]'; y = [ 3 4]';

sum( x.*y)
```

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II. **Part II:** Interpreting matlab code: In each case answer a few questions about the given matlab code.

2. (15 points) This problem refers to the following matlab program:

```
% ret contains return series of asset returns
T = length(ret); varp = 0.05; testRange = 501:T;
WT = length(testRange);
for t = testRange
    estPeriod = 1:t-1;
    rstar = quantile(ret(estPeriod),varp);
    eta(t) = (ret(t) <= rstar);
end
eta = eta(testRange); v1 = sum(eta); VR = v1/( varp*WT);

coin = [0, 1];
nboot = 10000;
v1b = zeros(nboot,1);
for i = 1 : nboot
    etab = sample(coin, WT,[(1-varp) varp]);
    v1b(i) = sum(etab);
end
 [v1 varp*WT VR]
mean( v1b > v1)
```

a.) What is v1 measuring?

Number of VaR violations/exceptions at 5 percent level.

b.) What is VR measuring, and if the VaR model estimation is correct, then what value do you expect for it?

Ratio of exceptions/expected exceptions, should be close to 1

c.) Which range of data does this model use in estimating the historical VaR at time t?

1 to t-1. Entire sample up until time t. (This is different from class example.)

3.(20 points) This problem refers to the following matlab program:

```
startspread = 10; stopspread  = 1;
ndays = 500;niterat = 1000; rannual = 0.03;
rdaily = rannual/250;
for i=1:niterat
    [p1, p2] = pairsgen(ndays,startspread);
    shares1 = 100/p1(1); shares2 = 100/p2(1);
    dist = p2-p1;
    stopdate = find(dist<stopspread);
    if(all(dist>stopspread))
        stopdate = ndays;
    else
        stopdate = stopdate(1);
    end
    val(i) = (shares1*p1(stopdate)-shares2*p2(stopdate)/...
          (1+rdaily*stopdate);
    mmkt = shares1*p1 - shares2*p2;
    liq(i) = min( mmkt(1:stopdate));
end
quantile(val,0.01)
quantile(liq,0.01)
```

a.) What does the variable "ndays" represent here?
Maximum number of days to run the strategy.

b.) Can stopdate be a vector, and if so why do we only care about stopdate(1) in this program?
Yes, it is all days when the prices are close. The first is the only one that matters since the strategy stops there.

c.) Which variable tries to replicate potential intermediate cash flows on this long/short position?
mmkt

d.) Why might strategies which are profitable in the long run be difficult to actually implement?

Profitable long run strategies, may lose a lot of money in the short term, before they eventually turn a profit.

4. (15 points) Answer this question referring to the following matlab code:

```
% wldeqp contains equity indices
% date(col 1), US(col 2), nonUS dev(col 3), emerging(col 4)
alpha = 0.01;
eqret = (wldeqp(2:end,2:end)-...
(wldeqp(1:end-1,2:end)))./wldeqp(1:end-1,2:end);
nmc = 100000;m = [0 0];rho = 0.3;
vcv = [1 rho; rho 1];
copmc = normal(nmc, m, vcv);
u = normcdf(copmc(:,1),0,1);
v = normcdf(copmc(:,2),0,1);
usretmc  = quantile(eqret(:,1),u)';
emretmc =  quantile(eqret(:,3),v)';
portret = 0.5*usretmc + 0.5*emretmc;
portval = 100*(1+portret);
pc = quantile(portval,alpha);
```

a.) What type of copula is this program using?

Gaussian

b.) What is the marginal distribution for the vector usretmc? Will it be close to the actual data?

It is the empirical distribution for the returns. It will exactly equal the return data by construction.

c.) Rho controls the correlation across returns. If you wanted to estimate rho from the original series using the matlab function 'copulafit" what transformation would you need to apply to the original returns, eqret?

Need to transform the returns to uniform. Best way would be to use the empirical CDF, or some other assumed CDF.

Part III. Multiple choice (2 points each):

5. Confidence intervals report a range
   a.) which make you confident about your estimate.
   >b.) which contain the true value with a certain high probability.
   c.) which contain the estimated value with a certain high probability.
   d.) generally don't use sample information to be calculated.

6. The skew of a log normal distribution is always
   >a.) positive.
   b.) negative.
   c.) 0
   d.) 3

7. The VIX index is best used to
   a.) forecast interest rates.
   b.) forecast bond defaults.
   >c.) forecast equity volatility.
   d.) forecast market liquidity.

8. The market risk capital formula in Basel II (and probably Basel III) requires firms to hold larger reserves when
   >a.) recent levels of VaR are larger.
   b.) the yield curve is steeper.
   c.) systemic risk is larger.
   d.) Price/earnings ratios are large.

9. A key contributor to the Barings Bank downfall was that
   a.) VaR probability levels were set too high.
   b.) expected shortfall should have been used instead of VaR.
   c.) the Nikkei futures market was very thinly traded.
   >d.) the back office and the trading desk were managed by the same person.

10. Long Term Capital Management used
   >a.) VaR, and estimated annual VaR at about 1 quarter of their capital reserves.
   b.) VaR, and estimated annual VaR at over 4 times their capital reserves.
   c.) only primitive measures of risk.
   d.) management compensation systems which diverged from investors' best interests.

12. The Orange county default was due to
    a.) the failure of a risky mortgage backed security.
    >b.) interest rate changes.
    c.) operational risk, since Citron lost much of the paperwork of the county's portfolio.
    d.) none of the above.

13. Liquidity risk will be a bigger problem for
    >a.) thinly traded mortgage backed securities.
    b.) a U.S. large stock equity portfolio.
    c.) a portfolio of near cash instruments (like U.S. treasuries).
    d.) a portfolio of large country foreign exchange positions.

14. From our simulations from class, a position hedged with a down and out barrier option can have less risk (as measured by VaR) than a position hedged with a vanilla put option. What is the key cause for this result?
    a.) The down and out barrier is **never** hit.
    b.) The option is more volatile than the equivalent Asian option.
    >c.) The barrier option is cheaper than the vanilla put.
    d.) The exotic option causes the portfolio distribution to be near normal.

15. One advantage of expected shortfall over VaR as a risk measure is that
    a.) it is easier to explain.
    >b.) it is more sensitive to small changes in the shape and location of the left tail of return distributions.
    c.) it is easier to calculate.
    d.) it can be used to estimate liquidity risk.

16. Our pairs trading example showed that
    >a.) intermediate cash flows can be very risky, even when the final outcome of the portfolio looks safe.
    b.) VaR completely measured pairs trading risk.
    c.) market neutral strategies are immune to any risk.
    d.) good trading pairs can be hard to find.

17. Under the Basel (II and III) arrangements when your VaR violations exceed their expected values by a large amount you will be required to
    >a.) increase reserves.
    b.) decrease reserves.
    c.) put fake numbers in your spreadsheets to get the right answer.
    d.) shift to an expected shortfall measure.

IV. Longer questions

18. (7 points) We mentioned several reasons for why default risk presents challenges for quantitative methods such as VaR. Name one of these.

Small probabilities/Long horizons/Thinly traded/Latent variables/Large losses

only one of these is needed.

19. (7 points) Risk on/risk off trading refers to the recent trend of increasing correlations in asset returns across many different classes. Think of this phenomenon as generating periods in which returns are relatively correlated, and other periods when they are not. If you are using a fixed VaR level could this lead to VaR violations which are correlated across time? Why or why not?

When correlations rise, the variance of a diversified portfolio will rise. The power of diversification to lower your risk decreases. If these correlations rise and fall over time, the general variance, risk, and probability of extreme moves of a portfolio will increase during these correlated times causing pockets of VaR exceptions (given that VaR levels are fixed). These translates into correlated exceptions since they are clumped in time.