**FINN 6216 Take Home Final - 2018**

**Usual software/hardware rules apply.**

1. Consider two stocks AMZN and MSFT, and let’s suppose you are really down on tech stocks, so you have 100 1-year puts on AMZN, strike 1300, volatility 20 percent, no dividend, risk-free rate 0.19%, and you have a short 1500 share position on MSFT. Assume absolute shifts, analytical delta and gamma with delta/gamma approximation, and compute (a) historical 1-day VaR 99% on data going back from 4/2/2018 to 4/1/2016, and (b) historical 10-day VaR 99% on data going back from 4/2/2018 to 3/19/2016. Also (c) compute 97% historical 1-day Expected Shortfall going back to 4/1/2016. Volatility and rate are static, only risk factors are stock prices.
2. Start with 3/19/2016, and consider 10-day non-overlapping absolute shifts (there should be around 50 or so) for each of the two stocks above. (a) Use the Jarque-Bera test to tell me if these shifts look normal for AMZN and MSFT. (b) Now take the 1-day relative shifts going back to 4/1/2016, and take their *absolute values,* for each stock.Use Ljung-Box on the correlogram up to a lag of 10 to tell me whether one should use a conditional model for risk management of the position in (1).
3. Assuming that the absolute shifts in (1) form an elliptical distribution, use the elliptical fitting algorithm to derive the estimated dispersion matrix and the location vector. Choose a value of radius R such that half the points fall outside that ellipse. Compute the conditional correlation on just those points, and compare it to the overall correlation.
4. Suppose there are only two credit ratings, good and default. Suppose that the risk-free rate is 0, you have two zero-coupon one-year risky bonds each (they are both “good”) with a par value of 100 and in the next year, there is a 0.8% chance that Bond 1 only will default, a 0.8% chance that Bond 2 only will default, and a 0.2% chance that they both will. Compute (a) the 1-year default correlation and (b) the 1-year 99.9% IRC. When computing the current value of the bonds, assume a recovery rate of 0.
5. Use the “quick and dirty” method to fit a 2d t distribution to the absolute shifts of (1) so that you get the overall covariance matrix matching the sample covariance matrix, the means matching, and the kurtosis being the average of the two individual kurtoses. (a) Compute 99% VaR using 5000 Monte Carlo scenarios, (b) empirical or analytical Spearman’s rho, and finally (c) lower tail dependence of this distribution’s copula. Finally (d) estimate (c) empirically by computing the conditional probability of a MSFT shift being among the n worst out of 5000 given that the AMZN shift is among the n worst, or vice versa. Do this for n = 100, 80, 60, 40 and 20, both ways.
6. Suppose your bank computes VaR using In the last 100 days you have already had 4 exceptions, where the loss on your existing positions (not including new additions) was bigger than the VaR. Should you start to doubt the quality of your VaR model? Why or why not?
7. You have a position of 100 1-year European put options on AMZN with a strike of 1300 as in (1), but no MSFT shares. Assume spot price equal to the close on April 2, volatility 20 percent, and you calculate the real-world drift based on the previous year’s data. Risk-free rate is 0.25%, dividend rate is 0%. You bought this option from a counterparty with a constant 2% (0.02) default hazard rate and no recovery if default occurs. Compute (a) the Potential Future Exposure (p = 0.95) profile, (b) Max PFE, (c) Expected Exposure profile, and (d) CVA. Finally, assume that the two risk factors are stock price and hazard rate and that volatility will not change tomorrow. Assume that the hazard rate can change tomorrow based on a normal random variable with a mean of 0 and a standard deviation of 0.001, and that relative changes in stock price and absolute changes in counterparty hazard rate have -0.5 correlation. Now (e) estimate the 1-day CVA VaR with a variance-covariance calculation (Make sure you get the sign right). By the way, do we have wrong-way risk in this situation?

**This Final is due on the last day of the semester, Friday May 4, at 6:30 PM. This is a HARD DEADLINE, since I have just 10 days after that to submit the final grades.**

**The annual FINN 6216 PIZZA PARTY will take place at 12404 Elkhorn Drive, 6:30 PM on Friday, April 27. If you do not have GPS, the directions from the north are: I-77 south to I-485 south, outer (or if you are closer to uptown, I-77 south to I-485 north, inner). Get off at Route 160 and go south. Go about ½ mile and make a right turn right after the Harris Teeter onto Shopton Road West. Take second exit from the traffic circle to stay on Shopton Rd. West. You will encounter a VERY sharp s-curve (careful!!), see the Siemens plant on the left, and then go over a narrow bridge with a firehouse on the other side. Make the first left after the bridge onto Egrets Point Drive, then left again onto Elkhorn, then go to the end. My house is on the left side of the cul-de-sac.**