Finance 4366 Final Exam Formula Sheet

I. Pricing a Forward Contract on a Dividend-Paying Stock:

$$F\,(t,T)\;=[S(t)-PV(D)]\times e^{rT},$$

where

$F(t,T)$ = today's (date t) price of a forward contract that matures at date T;
$S(t)$ = today's (date t) price of the underlying stock;
r = annualized riskless rate of interest; and
$PV(D)$ = present value of dividend payments received between date t and date T.

II. Value of a Forward Contract:

$$f(t,T)=(F(t,T)-K)e^{-rT},$$

where $f(t,T)$ represents the date t value of the forward contract which matures at date T and K is the delivery price for the forward contract.

III. Put-call Parity Equation (assuming no dividends; options are European):

$$c+Ke^{-rn\delta t}=p+S,$$

where

δt = the length of a timestep; e.g., if the timestep is one year, then δt= 1.
n = the number of timesteps until expiration;
$T = n\delta t$ = time until expiration;
c = value of a call option with an exercise price of K and n timesteps until expiration;
p = value of a put option with an exercise price of K and n timesteps until expiration;
r = the annualized riskless rate of interest; and
S = the value of the underlying asset.

IV. Risk Neutral Probability of an "up" move:

$$q=\frac{e^{r\delta t}-d}{u-d},$$

where q = the risk neutral probability of an "up" move; u = 1 plus the rate of return from an "up" move; and d = 1 plus the rate of return from a "down" move.

V. Risk Neutral Valuation Formula for pricing a 1-timestep European call or put option on a non-dividend paying stock:

$$f=e^{-r\delta t}[qf_u+(1-q)f_d],$$

where f_u = the value of the option at the u node; f_d = the value of the option at the d node, and f = the current arbitrage-free price of the option.

VI. Risk Neutral Valuation Formula for pricing an n-timestep European call option on a non-dividend paying stock; also known as the Cox-Ross-Rubinstein (CRR) Option Pricing Formula:

$$c = e^{-rn\delta t}\left[\sum_{j=a}^{n}\left(\frac{n!}{j!\,(n-j)!}\right)q^j(1-q)^{n-j}\left(u^j d^{n-j}S-K\right)\right],$$

where j correponds to the number of up moves which occur over the course of n timesteps and a = the smallest integer value $> \ln(K/Sd^n)/\ln(u/d)$.

VII. Black-Scholes-Merton European Option Pricing Formulas:

$$c = SN(d_1) - e^{-rT}KN(d_2) \text{ and } p = e^{-rT}KN(-d_2) - SN(-d_1),$$

where

$d_1 = \dfrac{\ln(S/K) + (r + .5\sigma^2)T}{\sigma\sqrt{T}}$; $\quad d_2 = d_1 - \sigma\sqrt{T}$;

σ = annualized volatility of underlying asset's rate of return;

$N(d_1)$= standard normal distribution evaluated at d_1;

$N(d_2)$= standard normal distribution evaluated at d_2;

$N(-d_1)$ = standard normal distribution evaluated at $-d_1$; and

$N(-d_2)$= standard normal distribution evaluated at $-d_2$.

VIII. Credit Risk:

- Value of Risky Debt $V(D)$: $V(D) = Be^{-rT} - V[\max(0, B-F)]$
- Value of Limited Liability Put $V[\max(0, B-F)]$: Determined by applying the Black-Scholes-Merton pricing formula for the value of a put option with underlying asset value $V(F)$ and exercise price B, where B is the promised payment to the firm's creditors;
- Yield to Maturity (YTM): Suppose $B = V(D)e^{YTM(T)}$. Then $YTM = \dfrac{\ln(B/V(D))}{T}$.
- Credit Risk Premium: Credit Risk Premium = $YTM - r$.