1. Derive an expression for the 6th central moment of a random variable in terms of its cumulant moments $\kappa_j$ for $1 \leq j \leq 6$.

2. Derive an expression for the third moment of the contingent (i.e. "per payment") excess loss variable $(X - d) |_{X > d}$ in terms of moments and limited moments of $X$.

3. For a random variable $X$ with continuous support derive expressions for the derivatives of $VaR_q$ and $CTE_q$ with respect to $q$, the probability level of the risk. What conclusion can you draw about $VaR$ compared to $CTE$ as a measure of risk?

4. Derive the two-parameter Pareto distribution $F(x) = 1 - \left(\frac{\theta}{\theta + x}\right)^\alpha$ from a maximum entropy principle followed by a series of transformations.

5. Let $S = M_1 + \ldots + M_N$ where $N$ is Poisson $\lambda = .75$ and $\{M_j\}$ are i.i.d. Binomial $m = 4$, $q = .25$ and independent of $N$. Calculate the probability that $S > 4$. Be accurate to at least 3 significant digits.

6. Let $K$ be Binomial $(m, q)$, $L$ be Poisson $\lambda$, and $M$ be Negative Binomial $(r, \beta)$ representing independent frequency of event variables. Suppose that in each case 25% of the events that actually occur fail to be recorded. Derive and identify (i.e. give their names and parameters) the corresponding frequency of recorded events variables, calling them $K^*$, $L^*$, and $M^*$. 
