Question: 1 Risk managers use a number of methods for managing risk. For each of the following, what method for handling risk is used? Explain your answer.

a. The decision not to carry earthquake insurance on a firm's main manufacturing plant
Answer: *Retention*. The firm is retaining the earthquake exposure.

b. The installation of an automatic sprinkler system in a hotel
Answer: *Risk control*. If a fire occurs, the sprinkler system will operate automatically to extinguish the fire, thereby reducing the size of the loss.

c. The decision not to produce a product that might result in a product liability lawsuit
Answer: *Avoidance*. The firm is avoiding a lawsuit by not manufacturing products that could injure customers who use the product.

d. Requiring retailers who sell the firm's product to sign an agreement releasing the firm from liability if the product injures someone
Answer: *Noninsurance transfer*. The firm manufacturing the product has transferred the risk of a liability suit to the retailers by such an agreement. This agreement is often called a hold-harmless agreement. For example, a manufacturer may insert a hold-harmless clause in a contract with a retailer by which the retailer agrees to hold the manufacturer harmless if a scaffold collapses and someone is injured.

Question: 2 Buildings in flood zones are difficult to insure by private insurers because the ideal requirements of an insurable risk are difficult to meet.

a. Identify the ideal requirements of an insurable risk.
Answer: Ideal requirements of an insurable risk:
- Large number of exposure units
- Accidental and unintentional loss
- Determinable and measurable loss
- No catastrophe loss
- Calculable chance of loss
- Economically feasible premium

b. Which of the requirements of an insurable risk are not met by the flood peril?
Answer: The requirement of not having a catastrophe loss is not met because large numbers of exposure units in a flood zone would be incurring losses at the same time. Also, the requirement of an economically feasible premium generally is not met. Without a government backup, premiums for flood insurance in major flood zones generally would be unaffordable for many insureds.

Question: 3 Compare the risks of (i) fire with (ii) war in terms of how well they meet the requirements of an ideally insurable risk.

Answer:

(i) Risk of fire

a. *Large number of exposure units.* This is generally met, since there are millions of homes that are insured.
b. *Accidental and unintentional loss.* This requirement is generally met, since most insureds do not deliberately start a fire.
c. *Determinable and measurable loss.* A fire loss can be determined and measured. In case of disagreement, a property insurance policy has a provision for resolving disputes.
d. *No catastrophic loss.* This requirement is met, since most homes do not burn at the same time.
e. *Calculable chance of loss.* Insurers can estimate within ranges the probability of a fire loss.
f. *Economically feasible premium.* For most insureds, this requirement is fulfilled.

(ii) Risk of war

a. *Large number of exposure units.* This requirement is not fulfilled. Based on the law of large numbers, it is difficult to estimate accurately the number of wars that will occur.
b. *Accidental and unintentional loss.* This requirement is not met. Most wars are not accidental, but intentional.
c. *Determinable and measurable loss.* Although a war loss can be determined, the
d. measurement of loss would be difficult.
e. *No catastrophic loss.* This requirement is not fulfilled, since large numbers of exposure
f. units would simultaneously incur losses.
g. *Calculable chance of loss.* This requirement cannot be easily met.
h. *Economically feasible premium.* Because of the catastrophic potential of war, the premiums would not be economically feasible.

Question: 4 There is a 40% probability that the economy will be good next year and a 60% probability that it will be bad. If the economy is good, there is a 50 percent probability of a bull market, a 30% probability of a normal market, and a 20% probability of a bear market. If the economy is bad, there is a 20% probability of a bull market, a 30% probability of a normal market, and a 50% probability of a bear market. What is the probability of a bull market next year?

Answer:

Because a good economy and a bad economy are mutually exclusive, the probability of a bull market is the sum of the joint probabilities of (good economy and bull market) and (bad economy and bull market): **(0.40 × 0.50) + (0.60 × 0.20) = 0.32 or 32%.**

Question: 5 Joe Mayer, CFA, projects that XYZ Company's return on equity varies with the state of the economy in the following way:

State of Economy	*Probability of Occurrence*	*Company Returns*
Good	.20	20%
Normal	.50	15%
Poor	.30	10%

The standard deviation of XYZ's expected return on equity is *closest to:*

Answer:

In order to calculate the standard deviation of the company returns, first calculate the expected return, then the variance, and the standard deviation is the square root of the variance.

The expected value of the company return is the probability weighted average of the possible outcomes: **(0.20)(0.20) + (0.50)(0.15) + (0.30)(0.10) = 0.145.**

The variance is the sum of the probability of each outcome multiplied by the squared deviation of each outcome from the expected return:

$$\mathbf{(0.2)(0.20 - 0.145)^2 + (0.5)(0.15 - 0.145)^2 + (0.3)(0.1 - 0.145)^2}$$
$$\mathbf{= 0.000605 + 0.0000125 + 0.0006075 = 0.001225.}$$

The standard deviation is **the square root of 0.001225 = 0.035 or 3.5%.**

Question: 6 The following information is provided for a stock market:

	σ_j	ρ_{jM}
Security A	50%	0.6
Security B	60%	−0.2
Market Portfolio	20%	1.0

Notation: σ_j = standard deviation of the rate of return on asset j = A and j = B; ρ_{jM} = correlation coefficient between the return on asset j and the return on the market portfolio. The mean rate of return on the market portfolio is 8% and the risk-free rate of return is 5%.

In the Capital Asset Pricing Model, explain what is meant by the beta coefficient, β_j , for a security. Calculate the beta coefficients for the two securities from the given information.

Answer:

Beta is a measure of the volatility, or systematic risk, of a security or a portfolio in comparison to the market as a whole. Beta is used in the capital asset pricing model (CAPM), a model that calculates the expected return of an asset based on its beta and expected market returns.

Given the formula to calculate for beta: $\beta_j = \frac{Cov(R_j, R_m)}{Var(R_m)}$, when $Cov(R_j, R_m) = \rho_{jM}\sigma_j\sigma_M$.

Hence, we have that:

	Covariance	**Var(Rm)**	**beta**
security A	0.0600	0.04	1.50
security B	-0.0240	0.04	-0.60

Question: 7 Assume that S&P 500 at close of trading yesterday was 1,040 and the daily volatility of the index was estimated as 1% per day at that time. The parameters in a GARCH(1,1) model are $\omega = 0.000002$, $\alpha = 0.06$, and $\beta = 0.92$. If the level of the index at close of trading today is 1,060, what is the new volatility estimate?

Answer:

With the usual notation, $u_{n-1} = 10/1040$ = 0.01923, so that

$$\sigma_n^2 = 0.000002 + 0.06 \times 0.01923^2 + 0.92 \times 0.01^2 = 0.0001162 .$$

This gives $\sigma_n = 0.01078$. The new volatility estimate is therefore 1.078% per day.

Question: 8 Suppose that GARCH(1,1) parameters have been estimated as $\omega = 0.000003$, $\alpha = 0.04$, and $\beta = 0.94$. The current daily volatility is estimated to be 1%. Estimate the daily volatility in 30 days.

Answer:

In this case, V_L = 0.00015 and the expected variance rate in 30 days is 0.000123. The volatility is 1.11% per day.

Question: 9 Suppose that GARCH(1,1) parameters have been estimated as $\omega = 0.000002$, $\alpha = 0.04$, and $\beta = 0.94$. The current daily volatility is estimated to be 1.3%. Estimate the volatility per annum that should be used to price a 20-day option.

Answer:

In equation that:

$$\sigma(T) = \sqrt{252\left\{V_L + \frac{1-e^{-aT}}{aT}\left[V(0) - V_L\right]\right\}}, \text{ where } a = \ln\frac{1}{\alpha+\beta}.$$

We have V_L =0.0001, a = 0.0202, T = 20, and V(0) =0.000169, so that the volatility is 19.88%.

Question: 10 Analyze data in the below table.

State	Real World (%)	Normal Model (%)	Prob(v>x)	ln(x)	ln[Prob(v>x)]
1	25.04	31.73	**0.1252**	0	**-2.0778**
2	5.27	4.55	**0.02635**	0.6931	**-3.6363**
3	1.34	0.27	**0.0067**	1.0986	**-5.0056**
4	0.29	0.01	**0.00145**	1.3863	**-6.5362**
5	0.08	0	**0.0004**	1.6094	**-7.824**
6	0.03	0	**0.00015**	1.7918	**-8.8049**

If distribution of market variable follows power law, what are key estimated parameters from using all observations in the table?

Answer:

From that $Prob(v > x) = Kx^{-\alpha}$, we can transform to $\ln[Prob(v > x)] = \ln K - \alpha \ln x$, or $Y^* = \delta + \beta X^*$. We know that:

$$\beta = \sum_{i=1}^{n} x_i y_i \Big/ \sum_{i=1}^{n} x_i^2$$, where where x_i and y_i are deviation from mean.

We can have that:

	X = ln(x)	Y = ln[Prob(v>x)]	$\sum_{i=1}^{n} x_i y_i$	$\sum_{i=1}^{n} x_i^2$
	0	-2.0778	-3.91	1.20
	0.6931	-3.6363	-0.81	0.16
	1.0986	-5.0056	0.00	0.00
	1.3863	-6.5362	-0.26	0.08
	1.6094	-7.824	-1.12	0.26
	1.7918	-8.8049	-2.20	0.48
Average	**1.0965**	**-5.6475**		
Summation			**-8.29**	**2.20**

Therefore, beta = -8.29/2.20 = -3.78, implying that alpha = 3.78, and $\delta = \bar{Y}^* - \beta \bar{X}^* = -5.6475 - (-3.78 \times 1.0965) = -1.50$, which leads to $K = \exp(-1.50) = 0.2219$. The Power Law model for this market variable becomes:

$$Prob(v > x) = (0.2219) x^{-3.78}.$$