Risk measurement

MODULE 3

Frequency and severity of losses.

- Frequency of loss refers to number of times in a given pe loss is likely to happen.
- Historical data will provide this info. (Eg: frequency of inju of injuries in the past/no of worker-years) in the absence historical data, industry data can be used. Informed judg can be used as well.
- Severity of loss measures the magnitude of loss per occu One way to estimate is from historical data. (average severity/occurrence)
- Expected loss = frequency of loss*severity of loss. Expecte affects business value and insurance pricing.

3.6

Property Exposures	Frequency	Severity Range	Average Severity	Expected Loss
Damage to automobiles	Medium	$0–$20,000	Low	Medium
Stolen property	High	0–2,000	Low	Low
Small fires	Low	100,000–500,000	Medium	Low
Major fires	Low	500,000–10,000,000	High	Low

Note:

- Std deviation for high freque
  low severity is low while std
  deviation for low frequency
  severity is high
- Infrequent but potentially la
  losses are less predictable a
  pose greater risk than more
  frequent smaller losses.

Risk control

- Risk control is the process of implementing measures to reduce risk associated with a hazard.
- Benefits of risk/loss control:

Elimination of expenses associated with

- Repair or replacement of damaged property
- Income losses due to distruction of property
- Extra costs associated with maintaining operations
- Adverse liability judgements
- Medical costs to treat injuries
- Income losses due to death/disabilities

Cost of risk control

- Installation and maintainance expenses eg sprinkler system
- There are associated costs involved like employee benefits apart from salary
- Some measures push up utility bills eg power bill

Risk control techniques

1. Risk avoidance
2. Risk prevention
3. Risk reduction

Risk avoidance

- Risk avoidance involves not performing an activity that c
risk. Eg: not buying a property, not flying, not travelling. Th
loss of opportunities arising out of performing such activiti
doing a business will avoid risk but one loses on opportuni
profits.
- Advantages:
- Chances of risk is reduced to zero in case where loss expo
not started. In situations where exposure has already start
reduce to zero for future activities. Residual risks may still p
- Disadvantages:
- A firm cannot avoid all losses like premature death of an
- It is not feasible/practical to avoid all losses without shutti
business eg car factory cannot avoid all risks if it has to co
producing cars

Risk control techniques- Risk prevention

- It refers to measures that reduce the freq of a particular loss. This focusses on stopp losses from happening. Important to prev death/injury to people.
- Businesses employ loss control engineers identify sources of risks and institute corre actions. Like poor lighting, poor maintena improper security, etc. training is given or aspects
- Eg: changing slippery floor, building safet enclosures to dangerous machinery etc

Risk control techniques- Risk reduction

Risk financing techniques-risk retention.

Risk financing techniques-risk transfers.

Risk management decision methods

- Risk avoidance
- Loss control
- Risk retension
- Non-insurance transfers
- insurance

Pooling arrangements and diversification of risk

- Most popular risk management tool is diversification. Es part of insurance/financial markets
- Simple methods like pooling between two to diversifica amongst many
- Pooling arrangement reduces risk when losses are indep (uncorrelated)
- Pooling refers to spreading losses incurred by a few ove entire group so that everyone bears average loss instea actual loss.

2-person pooling arrangem

- Shahrukh and Salman have a possib of an accident in the coming year,
- 20% chance of an accident with a 2500
- Probability distribution of accident is highly skewed. (0 – 0.8; 2500 – 0.2)
- Their losses are uncorrelated.
- What is the expected loss and stand deviation for each one of them?

- Expected loss = 0.8*0 + 0.2*2
  = 500
- Standard deviation
  = Root 0.8(0-500)^2 + 0.2(250
  500)^2
  = 1000

Pooling arrangement…

- Pooling allows them to poo
  their risk and split losses equ
- What is the expected loss o
  standard deviation for eac
  one of them?

Pooling arrangement..

Possible outcome	Total cost	Cost paid by each person	Probabilit
Neither Shahrukh nor salman	0	0	0.8*0.8=0
Only Shahrukh	2500	1250	0.2*0.8=0
Only salman	2500	1250	0.2*0.8=0
Both of them	5000	2500	0.2*0.2=0

- Expected cost = 0.64*0+0.32*1250+0.04*2500 = 500
- Standard Deviation = Root of $0.64*(0-500)^2 + 0.32*(1250-5$ $(2500-500)^2 = 707$
- Pooling arrangement doesn't char either person's expected cost but i reduces the standard deviation. (1 707)
- This is how risk gets reduced by diversification. Loss has become m predictable.

Many-people pooling

- Assume that now Amir khan who has the same probability of risk also joins the pooling arrange If anyone meets with an accident, each will sh one-thirds of the average loss or expected loss
- ***As more and more people join the pool, the m loss remains the same but standard deviation down hereby reducing the risk for each partic***
- ***Expected loss or mean remains the same but t standard deviation further decreases making t normal distribution less skewed and more bell***
- Note that here the risk is not transferred to any else, but it is reduced as a whole for each poo participant.

Fig 4.2 page 59

- Graph with pooling
- Graph without pooling

summary

- As the number of participants in a pooling arrangement goes up, the standard deviation coming down as near to zero as possible for ea participant. Probability of extreme high or low outcome is reduced. This leads to the law of lar numbers.
- Law of large numbers states that "The greater t number of exposures, the more closely will actu results approach the probable result that are expected from an infinite number of exposures tossing a coin a million times)
- Also, as the number increases the probability distribution curve of average loss tends to beco more and more bell shaped tending towards a Normal distribution. This reflects central limit the

Solve

- Suppose each participant in a pool arrangement has USD 0 to 4000 loss with each participants expected lo usd 1000, sketch the probability distribution of average losses if the l across the participants are indepen and if
- 1. there is 1 participant (no pooling)
- 2. there are 100 participants
- 3. there are 1000 participants.

Pooling with correlated loss

Positive correlation because of:

- Catastrophe and epidemic hit a large populati the same time
- When losses are correlated then increase/decr one leads to increase/decrease in another.
- Therefore, Pooling arrangement reduces risk for participant even when the losses are positively correlated ***but to a lesser degree.***
- Assuming Shah Ruk and Salman's accidents are correlated, then probability of shah Ruk having accident knowing that Salman has had an acc > 0.04

Changing scope of financial management

Changing scope of risk management

- Traditionally risk management focused o loss exposures including property risks, risks and personal risks.
- In 1990s new trend emerged whe management included speculative fi risks.
- Recently some businesses have expande scope to include all risks.

Financial risk management

- Financial risk management refer
identification, analysis and treatme
speculative financial risks which includes
  - commodity price risk
  - interest rate risk
  - currency exchange rate risk
- Commodity price risk: it is the risk of
money if the price of a commodity cha
Both producers/sellers and users have t
Eg: agri grains

Futures&options can be used to hedge t

Financial risk management

- Interest rate risk:

Risk of loss caused by averse interes
movements. Eg: a bank has loaned h
loan for 20-30 years at a particular interes
If rates go up, they have to borrow deposi
higher rate. Similarly a corporate may
issued bond o public at a rate, they have
pay the coupon rate

- Currency exchange rate:

Exchange rate is the value at which
country's currency is converted to a
Nation's currency. This affects both impor
exports.

History of Managing financial

- Traditionally pure risk and speculative ris different and handled by separate departr
- Pure risk by risk retention, risk transfer a control.
- Speculative risk handled by finance through contractual provisions and capital instruments.

- contractual provisions include call feat bonds and adjustable interest rate provis mortgages

- capital market approaches include fo futures options and swaps.

History

- In the 1990s some companies started taking a view of pure and speculative risk to achiev advantage by combining both the risk coverag
- In 1997, Honeywell became the first company t into an "integrated risk program" with AIG.
- An integrated risk program is a risk treatment tec that combines coverage for pure and speculat in the same contract. Honeywell covered tra property and casualty insurance as well as co for currency exchange rate risk.
- Some companies created a new position calle risk officer(CRO) who is responsible for treatm pure and speculative risks in the organization.

History

- Combining two risks in the same contract makes it cheaper. Companies who can afford a certain level of loss can go fo trigger option where the insurance company pays only if tw specified losses occur like one property claim and another e rate claim. Such contracts are cheaper.

Enterprise risk management

- some companies went a step further and covered pyre risk, speculative risk, strategic risks and operational risks.
- Strategic risk refers to uncertainty regarding the organizatio and objectives and the organization's strengths, weaknesse opportunities and threats.
- Operational risk refers to risks that develop out of business op like manufacturing products and providing service to custo
- Combining all these risks in one package reduces risk as lon are not positively correlated. If they are negatively correlate be reduced significantly.

History

Advantages of ERM:

- Holistic treatment of risks
- Advantages over competing businesses.
- Positive impact upon revenues
- Reduction in earnings volatility
- Compliance with corporate governance guidelines

Barriers to ERP:

- Organisation culture
- Turf battles
- Perception of not a priority
- Lack of formal process
- Deficiencies in intellectual capital and technology

Futures and option basics

- Spot market: delivery based
- Example- buy wheat at 30,000/ton, sell sugar at 45000/to

Derivative contracts

- Futures market: right to buy/sell, usually no delivery, squa position.
- Eg: as a buyer buy wheat futures for june at Rs 25,000/to market price is 30,000. you square up position by selling s make Rs 5000. buy physical wheat at Rs 30,000 from spot Effective price is Rs 25000 which is futures contracted pri
- As a seller, sell wheat at Rs 40,000 in the june futures mar price crashes to Rs 20,000. you square up your position b spot. You make Rs 20,000. sell physical wheat at Rs 20,00 spot market. Effective price is Rs 40,000

Options contract

- Options contract can be used to protect against adverse pric movements.
- Call option – option to buy at a specified price during a spec period
- Put option – option to sell at a specified price during a specifie
- Both call and put have buyers/writers and sellers (4 legs)
- Many strategies like straddle, strangle, butterfly,...
- Simple option to protect a price drop is "covered put option"
- Eg: someone has 100 HUL shares at current market price of Rs fears a price drop but feels it may also increase.
- He buys a put option for a strike price of 900 paying a premiu
- If market drops to 800, then he exercise his 'in the money' opt makes 900-800-5 = Rs 95
- If market moves up to 1000, then the option is out-of-money a wishes not to exercise the option and loses only Rs 5 of premiu

Hedging with Futures

Hedging a commodity risk using futures contract:

- A corn grower estimates in May about 20,000 bushels of
  December. He notices a price of $2.90/bushel of futures
  December. He fears that the actual spot price in Decem
  be lower. So he books 4 contracts of size 4000 bushels ea
  $2.90/bushel. He will buy back 4 contracts to offset his po
- If market price is 2.5/bushel in December.
- Sale of 4 contracts at 2.90 in may …. 4*5000*2.90 = 580
- Buy-back at 2.50 in December …. 4*5000*2.50 = 50000
- Gain on futures contract = 58000-50000 = 8000
- Sale of physical stock in December = 4*5000*2.50 = 5000
- Total revenue = 50,000+8000 = 58000

Hedging with futures

- If market price is 3.00/bushel in December.
- Sale of 4 contracts at 2.90 in may …. 4*5000*2.90 = 580
- Buy-back at 3 in December …. 4*5000*3 = 60000
- Gain on futures contract = 58000-60000 = (2000)
- Sale of physical stock in December = 4*5000*3 = 60000
- Total revenue = 60,000-2000 = 58000

- So, no matter what the price is in December the farmer g contracted price of may of $ 58,000.

Solve,

1. You are having 100 shares of HUL and the current marke
   Rs 900. you fear that the market will crash and sell it in th
   futures market at Rs 950. in june the price of HUL comes

   Calculate your realisation

   What is your realisation if the price comes down to Rs 90
   your gain in the whole transaction?

2. Colgate palmolive is quoting at Rs 1000/share. You exp
   market to go up. So you buy futures at Rs 1050 for June.
   market goes to Rs 1250. what is your profit? What would
   happened if you had bought spot?

Insurance market dynamics

- Risk control, risk retention and risk transfer are t
methods of risk management
- Risk retention by current earnings, loss reserves,
borrowings or captive insurance
- Risk transfer by a property and liability insuranc
company.
- Decision needs to be taken about risk retention
transfer. It depends upon conditions in the insu
market-place.
- 3 imp factors influencing insurance market are:
- - underwriting cycle
- - consolidation in the insurance industry
- - securitisation of risk

1. Underwriting cycle

- Underwriting means "sign and accept liability unde
insurance policy), thus guaranteeing payment in c
or damage occurs"
- Underwriting cycle – property and liability insurance
fluctuate between periods of tight underwriting sta
and high premiums called 'hard' insurance market
periods of loose underwriting standards called 'soft'
insurance market.
- This is measured in terms of combined ratio which is
paid losses and loss adjustment expenses plus und
expenses to premiums
- If combined ratio is more than 1 (100%) then underw
operation is profitable. Less than 1 is loss making.
- Risk managers must study current status of the cycle
making retention transfer decisions. Buy when mark
and retain when the market is hard

Y underwriting cycle fluctuat

- 1. Insurance industry capacity - capacity refers relative level of surplus which is assets less liabili

  They reduce premium and go soft when they surplus and increase premium and go hard wh are deficit. Competition hastens this process.

  External factors like earthquake, 9/11, katrina increase claims and reduce surplus and harder market.

- 2. Investment returns- insurance business also is investor generating revenues from premium co They sell insurance at lower premiums expectin investment returns. this is called 'cashflow unde

2. Consolidation in industry

- Consolidation means combining of business organisatio through mergers and acquisitions.
- A number of trends have changed the insurance marke like
- - insurance company mergers and acquisitions
- - insurance brokerage mergers and acquisitions
- - cross-industry consolidations

- (Read george rejda page 68 for examples)

Securitisation of risk

- Securitisation of risk means that insurance risk is transfer
the capital market through creation of financial instrum
such as catastrophe bond, futures contract, options co
and other financial instruments.
- This increases capacity for insuraers and provides acce
capital of many investors.
- Weather is another factor that determines risk in insuran
weather bonds are floated to securitise it. A weather o
provides a payment if a specified weather contingenc

Loss forecasting

Done on the basis of statistical analysis of past losses.

Risk profiling or risk mapping refers to analyzing the severity frequency of various risks involved in the business.

Based on loss forecasting the manager is able to decide of control measures.

Loss forecasting is done on the basis of

- Probability analysis:
- Probability or chance of loss of an event refers to the lon frequency of accurrence. Probability distribution is mutu exclusive and collectively exhaustible list of all outcomes out of an event along with probability associated with e outcome.
-

- Statistical analysis:
- It talks about a distribution of losses and parameters asso with it like mean mode median regression analysis and n tables.
- Regression talks about relationship between one or more dependent variables and an independent variable. Eg Y
- Mortality table indicates probability of death at a particu mortality rate of 0.001at an age of 25 indicates that 1 ou insured will die during that year. If all the 1000 are insured each then the company has to pay 1 lakh. In order to de company has to collect Rs 1 lakh from 1000 insured whic to 100 per lakh of sum assured or 1 per 1000 sum assured
- Law of large numbers: