

# Advanced Investments

John Elder

- Introduction to Derivatives

## 2 Introduction to Derivatives

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- Introduction to Derivatives
  - Definitions
  - Futures
  - Options
  - Uses of derivatives
    - Hedging
    - Speculation
    - Arbitrage
  - Pricing
    - $C_0 = S_0 e^{-\delta T} N(d_1) - K e^{-rT} N(d_2)$

$$d_1 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r - \delta + \frac{\sigma^2}{2}\right)T}{\sigma \sqrt{T}} \quad d_2 = d_1 - \sigma \sqrt{T}$$

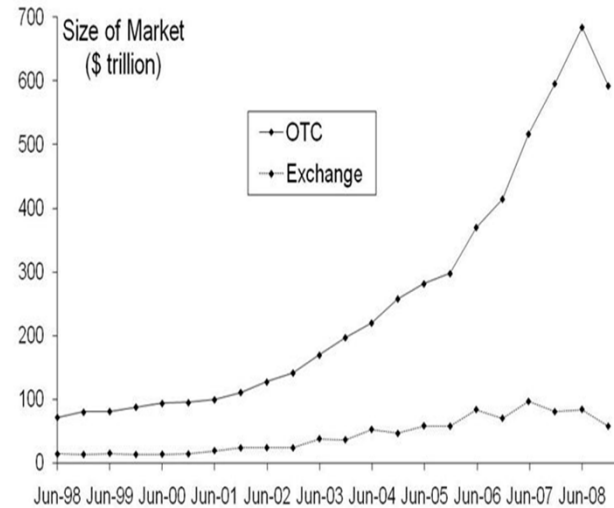
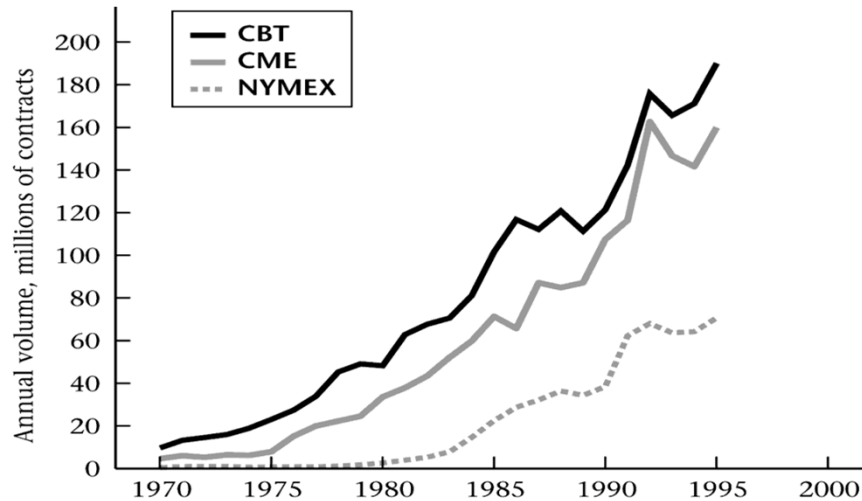
## 3 Derivatives

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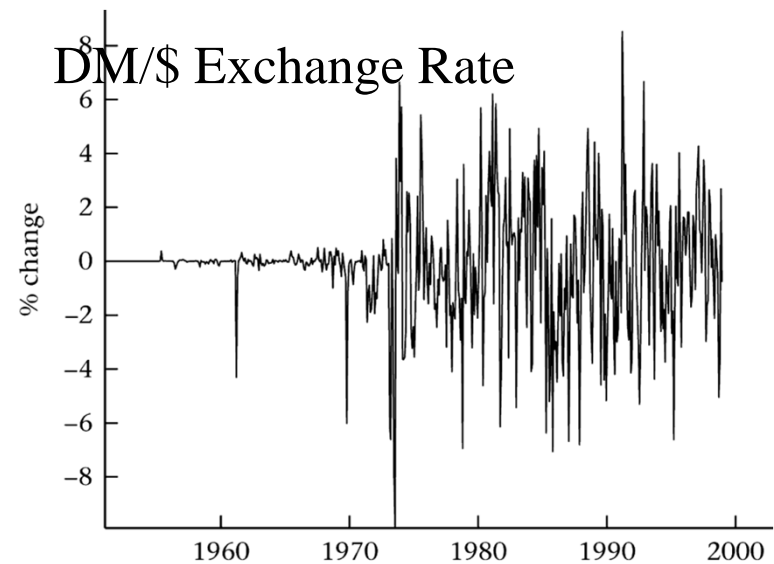
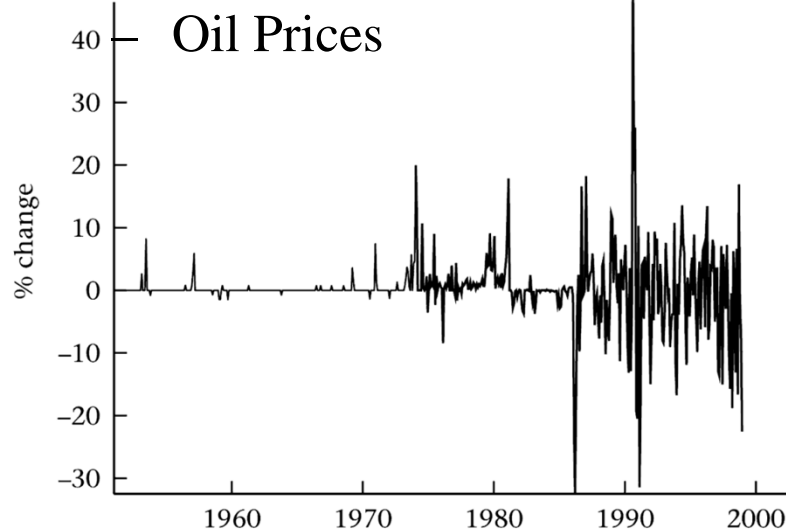
- Derivative - an instrument whose value depends on the values of other more basic underlying variables
  - Futures Contracts
  - Forward Contracts
  - Swaps
  - Options
- Uses of Derivatives (by corporations, investment mgrs and investors)
  - Hedge risks -
  - Speculate – make bet on future direction of mkt.
  - Arbitrage – lock in arbitrage profits
  - Change nature of a liability
  - Change investment without incurring costs of exchanging portfolio.
- Risk-free rate – We sometimes refer to T-bills as risk-free rate.
  - Large financial institutions usually price options off LIBOR.
  - LIBOR has small risk premium.

# 4 Derivatives – Growth and Drivers

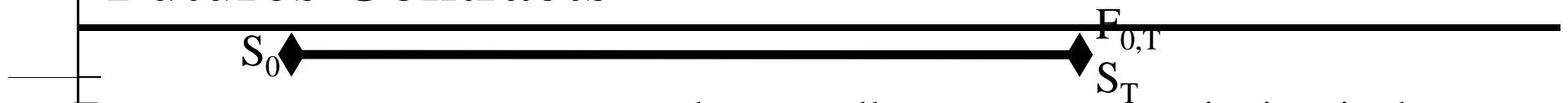
- Volume of exchange traded deriv
  - Explosion in 1980s in volume



- Increased volatility



## 5 Futures Contracts



- Futures contract - an agreement to buy or sell an asset at a certain time in the future for a certain price (known as the futures price).
  - $F_{0,T}$  price quoted at time 0 for an exchange at T.
  - Spot contract - an agreement to buy or sell an asset immediately.
- Futures contracts – see <http://www.futuresource.com>.
  - Agricultural – Livestock (cattle, pork bellies); Food/Fiber (coffee, sugar, OJ); Grains and oilseeds (corn, oats, soybeans..)
  - Metals and petroleum – Copper, gold, platinum, silver, crude oil, heating oil...
  - Financial futures – Interest Rate (T-bonds, EuroDollar..); FX; Stock index...
  - Other – weather (degree days, snowfall, wind), credit rating.
- Trading – many exchanges (see text). OTC market is very large.
  - Exchange Market – Offer standardized contract. Most visible to outsiders.
    - CBOT [1848], CME[1919], NYMEX, COMEX, EUREX, etc...
  - OTC Market - network of dealers that is much less regulated.
    - Participants include fin inst, corp treasurers, fund mgrs. Large volume.
  - Ag futures have long history. Financial futures mostly started in 1970's.

## 6 Futures Contract Examples

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- Agreement to:
  - buy 100 oz. of gold @ US\$800/oz. in April (COMEX (div of NYMEX))
  - sell £62,500 @ 1.9000 US\$/£ in March (CME)
  - sell 1,000 bbl. of oil @ US\$70/bbl. in April (NYMEX)
- Terminology –
  - The party that has agreed to buy has a long position
  - The party that has agreed to sell has a short position
- Q: What is this investor's profit?
  - January: investor enters long futures to buy 100 oz of gold @ \$800 in April
  - April: the price of gold \$815 per oz
- A: Profit is
  - $100\text{oz} * (\$815 - \$800) = \$1500$

# 7 Options

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- Option - contract giving holder the right, but not obligation, to buy (sell) an asset at fixed price (strike or exercise price) on or before a given date (expiration).
  - Call option – gives holder right to buy.....
  - Put option – gives holder right to sell.....
  - Writing options – sellers of options are said to “write” the contract.
  - Exercise is specified as at expiration (European) or any time prior (American).
- Types of Options
  - Stock Options - on individual stocks.
  - Stock Index Options – SP500 (SPX), SP100 NASDAQ-100, DJIA, R2000...  
Cash Payoff (not underlying assets); Contract multiplier is 100
  - Foreign Currency Options –
  - Interest Rate Options – T-bills, T-notes, T-bonds; GNMA pass-through
  - Futures Options – options on futures contracts.  
Most exchanges offering futures also offer options on futures.
- Trading – many exchanges (see text). OTC market is very large.
  - Exchanges – CBOE; American and Phil Stock Ex; Pacific Ex; Eurex.
  - OTC market – Allows contract to be tailored for large investors.

# Option Quote

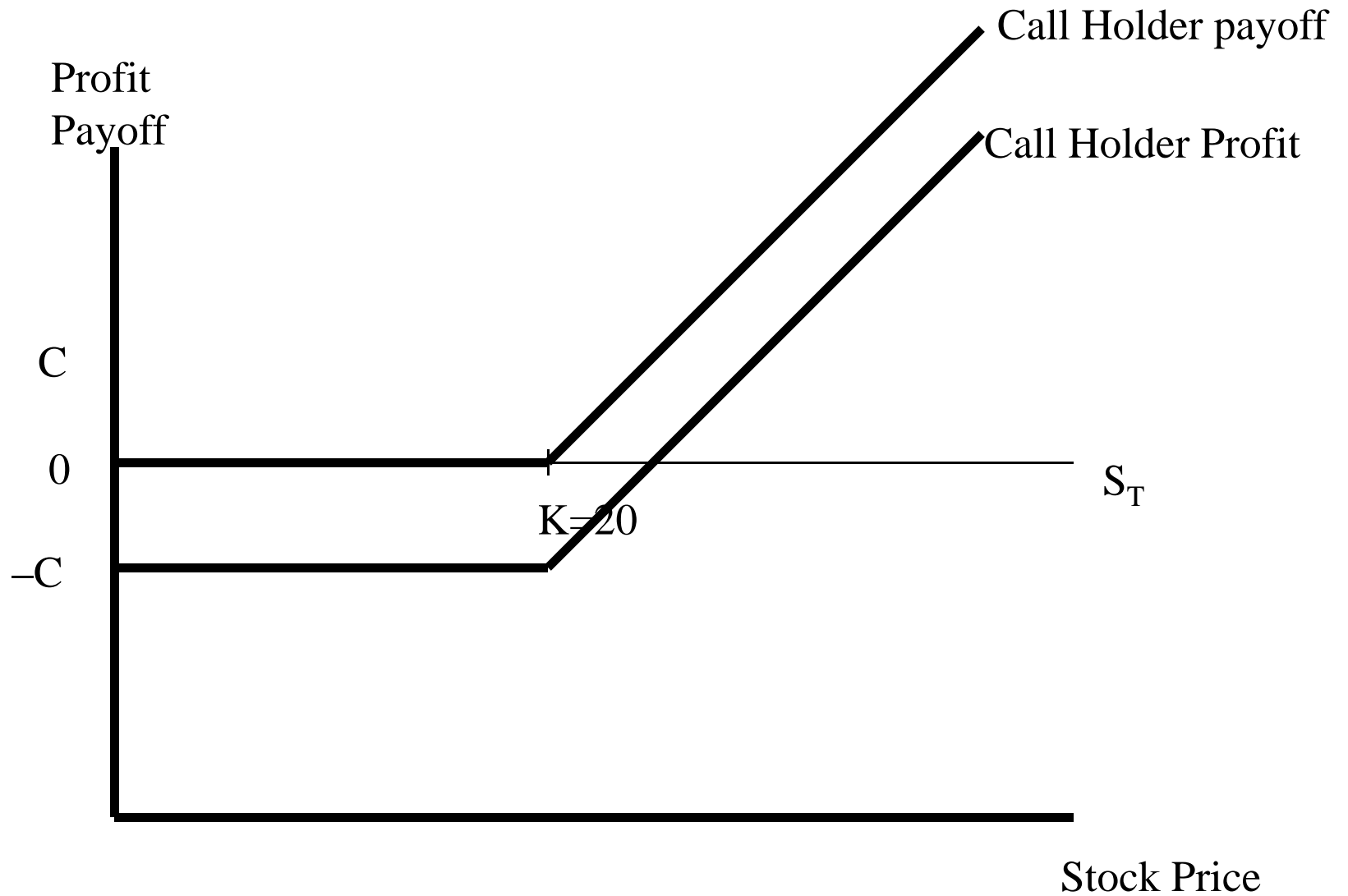
Example Option Prices (Stock Price=20.83)

Strike Price	June Call	July Call	Oct Call	June Put	July Put	Oct Put
20.00	1.25	1.60	2.40	0.45	0.85	1.50
22.50	0.20	0.45	1.15	1.85	2.20	2.85

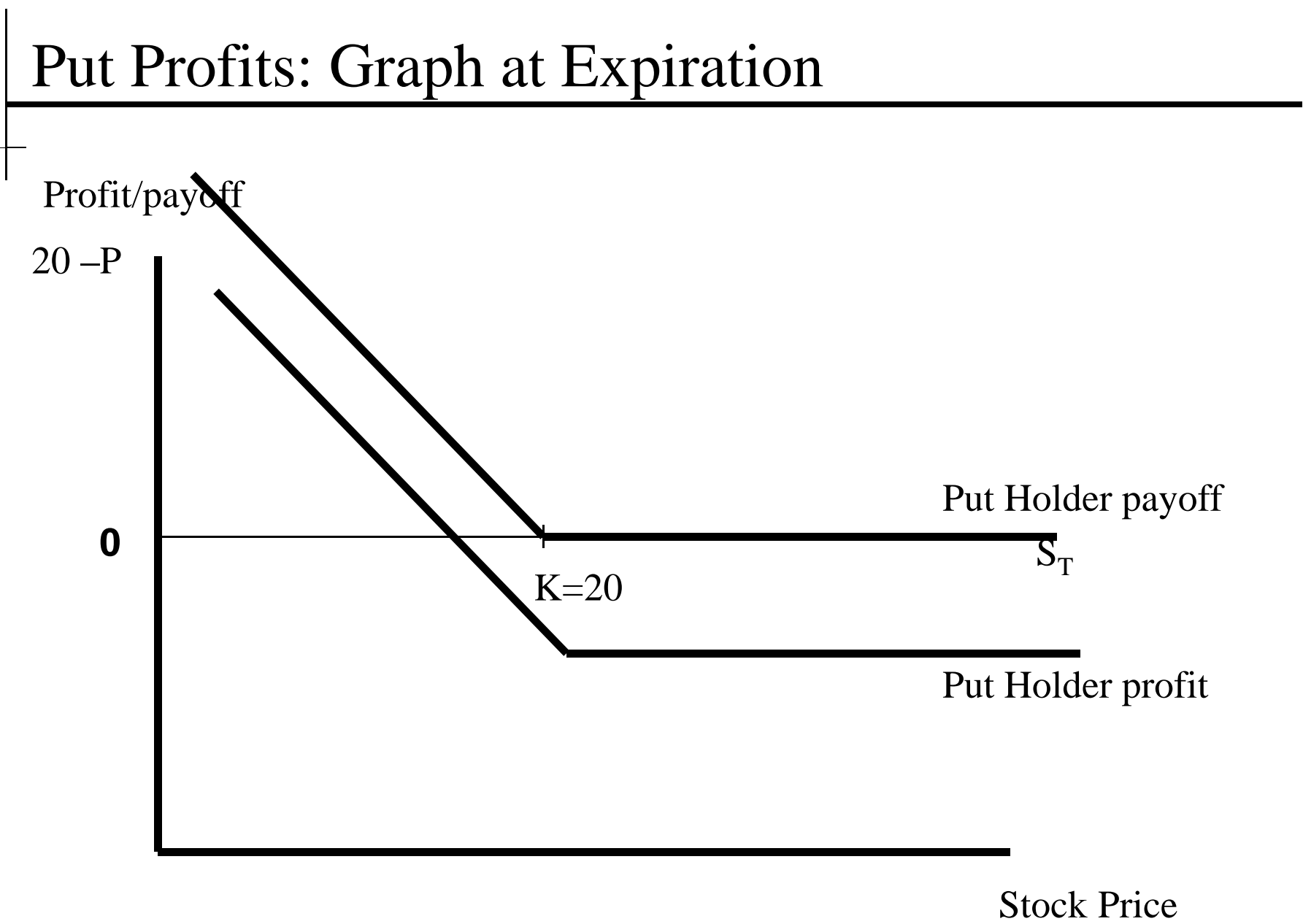
- Suppose you buy 60 contracts of July 20.00 call option. How much will you pay ignoring commissions?
- A1: 60 contracts x \$1.60 x 100 shares per contract = \$9,600
  - Contracts for 100 shares, so cost is *price*\*100.
  - Expire on third Friday of expiration month.
  - Option prices trade in nickel increments.
- **Note percent gain and loss!**

Stock Price	Payoff to Call	Payoff to Put
18	0	2
19	0	1
20	0	0
21	1	0
22	2	0

# 9 Call Profits: Graph at Expiration



# Put Profits: Graph at Expiration



# 11 Hedging, Speculation and Arbitrage

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- Traders

- Hedgers – seek to reduce risk
  - Futures obligates trade, so immunizes risk
  - Options gives right to exercise, so provides insurance.
- Speculators – assume risk for expected return.
  - scalpers – positions for minutes.
  - day traders – positions for less than day;
  - position traders – positions for days or weeks.
- Arbitrageurs – trade equivalent positions, e.g., based on parity.
- Spreader – use spreads (long-short) to exploit transitory price differentials.  
May be inter- or intra commodity or time-spreads.

- Speculation - Investor with \$4,000 expects a stock price will increase over next 2 mo. Stock price ( $S_T$ ) is currently \$40 and 2-mo call option with strike of 45 is \$2  
What are alternative strategies? What are profits if  $S_T = \$70$ ?  $S_T = 30$ ?
- A1: Buy stock (100 sh) at cost of \$4,000
- A2: Buy calls (20 contracts) at cost of \$4,000
- If  $S_T = \$70$ ,  
profit(1) =  $100 * (70 - 40) = \$3,000$ ;  
profit(2) =  $20 * 100(70 - 45 - 2) = \$46,000$ .

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## What sort of jobs are available?

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- Risk Manager - Minnetonka, MN (posted 2/10/2006 on behalf of Cargill)
- Cargill is an international provider of food, agricultural and risk management products and services. With 124,000 employees in 59 countries, the company is committed to using its knowledge and experience to collaborate with customers to help them succeed.
- Job Function: Direct the risk management effort within the Cargill Power and Gas Markets Business Unit.
- 25% Lead the quantitative and qualitative risk analysis activities of the 3-person Risk Group within the Cargill Power and Gas Markets BU. This role has particular responsibility for promoting a forward looking view of the BU risks and to generate regular discussions around these assessments.
- 25% Ensure compliance with all existing limits granted by Cargill's Commodity Risk Committee (CRC) and champion the establishment of additional limits as the growth and development of the business deem necessary.
- Coordinate and manage all necessary correspondence between the BU and the CRC. This includes risk profiles, limit extension requests and performance updates.
- 30% As a member of CPGM's management team, this role is expected to actively participate in initiatives that drive the strategic direction of the business.
- 20% Provide quantitative and qualitative risk management solutions to Cargill Energy Risk Management Solutions, the corporate natural gas hedging activity.

- Knowledge and Skill Requirements:
  - Undergraduate Degree in Finance, Accounting, or Economics
  - 7-yrs experience in a risk, trading, or financial control-related function
  - Previous Managerial Experience
  - Proficient in Intermediate Level Statistics and Quantitative Methods
  - Working knowledge of options including pricing models and the "greeks"
  - Proven strong verbal and written communication skills
  
- Desired:
  - Previous experience in the Energy Industry, primarily in Power and Gas
  - Previous experience in a Risk Management role
  - Understanding of Value at Risk (VaR) and stress testing including calculation
  - methodologies and model assumptions
  - Strong proficiency in Excel and data manipulation.
  - Must be a team player