数量与金融计算器的使用

一级培训项目

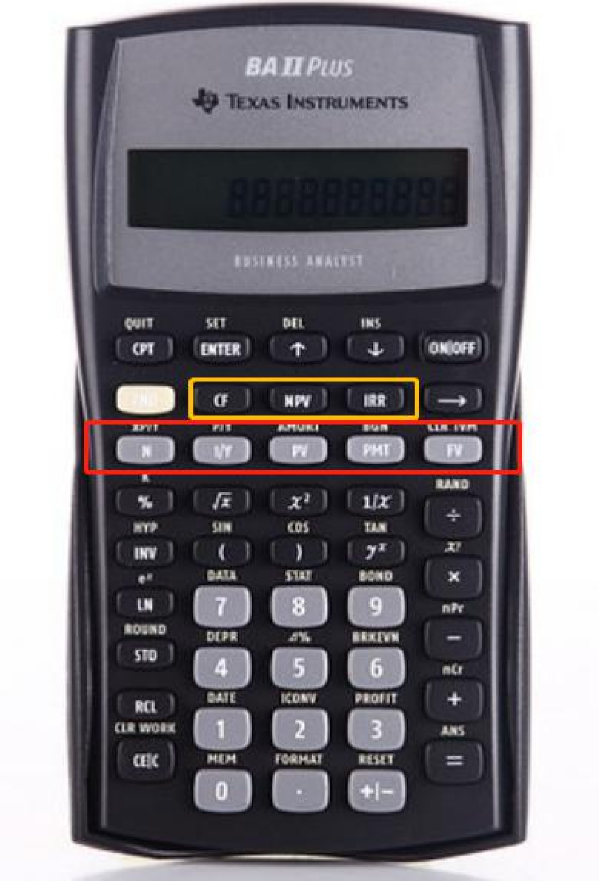
讲师：Mai

Framework

Quantitative Methods

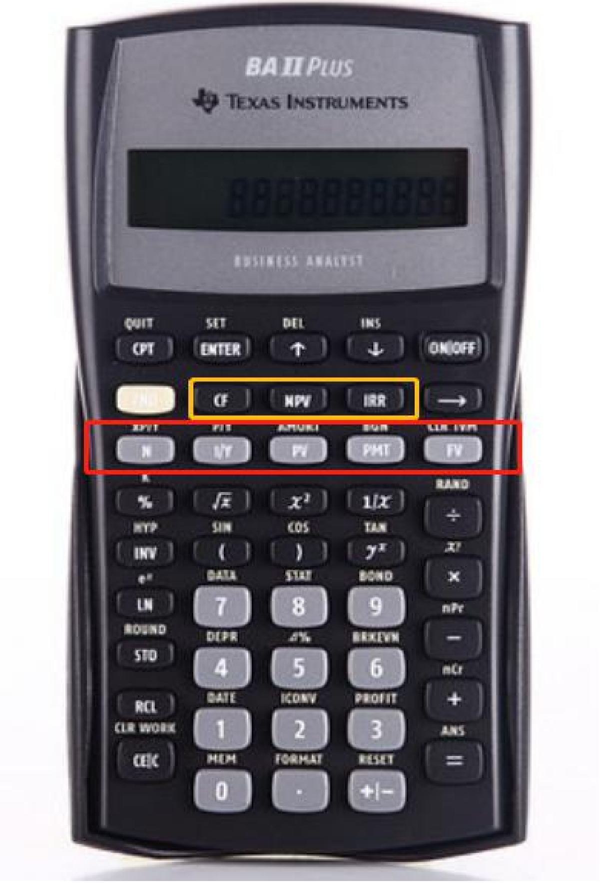
- **The Time Value of Money**
- Discounted Cash Flow Applications
- Statistical Concepts and Market Return
- Probability Concepts
- Common Probability Distributions
- Sampling and Estimation
- Hypothesis Testing
- Technical Analysis

Financial Calculator



- **Function keys: 【2ND】**
  - Press the 【2ND】 switch button first, and then press any key with secondary function, the second function is invoked.
  - E.g. 【2ND】→【CE/C】 Means that the 【CLRWORK】 function is invoked.
- **Set the decimal digits:【2ND】【•】→【FORMAT】**
  - Under the function of the FORMAT, Set to "AOS", rather than "Chn".

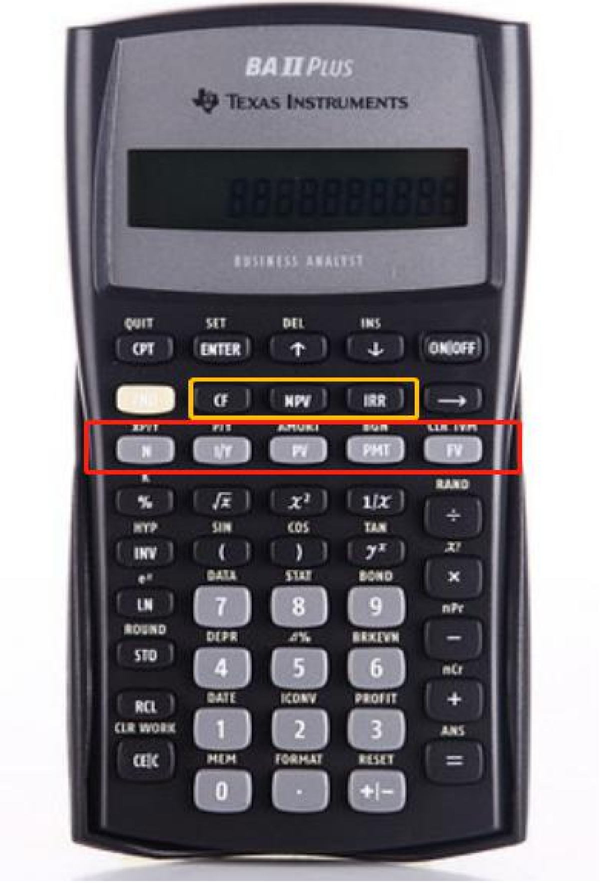
Financial Calculator



➤ **Common computing function operation:**

- -N　　-5 : 【5】【+|-】
- 1/N　　1/5: 【5】【1/x】
- e^x　　e^5: 【5】【2ND】【LN】
- y^x　　2^5: 【2】【y^x】【5】【=】
- nCr　　C_6^3: 【6】【2ND】【+】【3】【=】
- nPr　　P_6^3: 【6】【2ND】【-】【3】【=】

Financial Calculator



- Calculate the Date: Date interval function

- Example: From March 12, 2018 to May 15, 2019

【2nd】【1】month . day year :

【3】【.】【1218】

【ENTER】【↓】

month . day year : 【5】【.】【1519】

【ENTER】【↓】

【CPT】

Time Value

- **Time Value**
  - Required interest rate on a security
  - EAR
  - Annuities
  - NPV and IRR

Time Value of Money

- **Required rate of return is**
  - the minimum rate of return an investor must receive to accept the investment.
  - affected by the supply and demand of funds in the market;
  - usually for particular investment.
- **Discount rate is**
  - the interest rate we use to discount payments to be made in the future.
  - usually used interchangeably with the interest rate.
- **Opportunity cost is**
  - It is the value that investors forgo by choosing a particular course of action.
  - Understood as a form of interest rate.

Time Value of Money

- **Decompose required rate of return:**
  - Nominal risk-free rate = real risk-free rate + expected inflation rate
  - Required interest rate on a security = nominal risk-free rate + default risk premium + liquidity risk premium + maturity risk premium
- **Risk premium:**
  - Default risk premium: fail to make a promised payment at the contracted time and in the contracted amount
  - Liquidity premium: the risk of loss relative to an investment`s fair value if the investment needs to be converted to cash quickly. (some infrequently trading bonds)
  - Maturity premium: change in market interest rates as maturity extended (holding all else equal)

Time Value of Money

EAR calculation:

$$\boxed{\text{EAR}=(1+\text{periodic rate})^{m}-1} \longleftrightarrow 1+EAR=\left(1+\frac{r}{m}\right)^{m}=e^{r}$$

- 那么如果是semi, m=2; 如果是quarterly, m=4
- 如果是连续复利，公式则变为EAR = $e^{\text{annual int}}$-1

考察方法：

- 计算——算EAR，或者是算计息次数
- 性质（EAR和计息次数有关）
  - ✓ The more frequency of compounding，the larger the EAR
  - ✓ The largest EAR exists if it is continuously compounding

Example: EAR Calculation

- Calculate a stated annual interest rate of 10 percent generates different ending dollar amounts for annual, semiannual, quarterly, monthly, daily, and continuous compounding of an initial investment of $1 (carried out to four decimal places)

The Effect of Compounding Frequency on Future Value			
Frequency	r/m	m	Future Value of 1$
Annual	10%/1=10%	1*1=1	1.1
Semiannual	10%/2=5%	2*1=2	1.1025
Quarterly	10%/4=2.5%	4*1=4	1.103813
Monthly	10%/12=0.8333%	12*1=12	1.104713
Daily	10%/365=0.0274%	365*1=365	1.105156
Continuous			1.105171

Time Value of Money

- **Future value (FV):** Amount to which investment grows after one or more compounding periods.
- **Present value (PV):** Current value of some future cash flow
  - **Annuities:** is a finite set of level sequential cash flows.
    - ✓ equal intervals
    - ✓ equal amount of cash flows
    - ✓ same direction
- **内容：**
  - 【N】= number of periods 【CPT】=compute
  - 【I/Y】= interest rate per period 【2ND】【CE|C】=Remove all of the Cash flow data
  - 【PV】= present value
  - 【PMT】= amount of each periodic payment
  - 【FV】= future value
  - When input the【I/Y】 Don't need to add percent E.g.: I/Y=10%，Direct input 10

Time Value of Money

- An example of **ordinary annuities（后付年金）:**
- **Example**: Doctor Zhao joins a ordinary annuities with $100 annual deposit at each of the end of next 3 year. Suppose the deposit rate is 10 percent annually, what`s the FV?
- **Correct Answer:**
  - Enter relevant data for calculate.
    - ✓ N=3, I/Y=10, PMT=-100, PV=0, CPT→FV=331.

Time Value of Money

- **About an annuity due（先付年金）**
  - Definition: The first cash flow occurs immediately(at t=0)

  - Calculation:
    - ✓ **Measure 1:** use calculator, put the calculator in the **BGN** mode and input relevant data.
    - ✓ **Measure 2:** treat as an ordinary annuity and simply multiple the resulting PV by (1+I/Y)
      - ◆PV and FV calculation applies, while PMT not.
    - ✓ **Measure 3:** treat as an ordinary annuity and simply plus the resulting PV by PMT

Example: Investment of a Project

1. A company plans to invest a project B which pays $500 annually for three years and the first payment occurring today. The annual discounted at a 6%, what is the (PV) of this investment?

➢ **Solution:**

- Using the function of 2ND and switch to BGN mode :
  ([2ND] [BGN], [2ND] [SET], [2ND] [QUIT])
- Input N=3, I/Y=6, PMT=500, FV=0, CPT PV=-1,416.7

Example: Education fee

- The annual tuition fee for Doctor Li`s son to college is 40K, and need to be paid at the beginning lasting for 7 years until graduation. If the market interest rate is 6%, calculate the amount of money that Doctor Li needs to prepare today ?

- **Solution:**

  Using the function of TVM and switch to BGN mode :

  ([2ND] [BGN], [2ND] [SET], [2ND] [QUIT])

  Input N=7, I/Y=6, PMT=40,000, FV=0

  CPT PV=-236,692.97

Example: Pension plan

- Doctor Zhao is 55 years old now and plans to retire form today. If she requires an amount of 1,000 at the beginning of each year and the annual investment return for her is 5%, calculate the total amount of money she has to prepare for her 20-year remaining life.

- **Solution:**
- Using the function of [2ND] and switch to BGN mode :
  Input N=20, I/Y=5, FV=0, PMT=1,000, CPT PV=-13,085.32

Example: Mortgage loan

- Doctor Li is planning to purchase a $120,000 house by making a down payment of $20,000 and borrowing the rest amount with a 30 year mortgage monthly. The bank will lend the money at a rate of 8%, the loan will be paid off equal at the end-of-month, what will the PMT of Doctor Li be?
- **Solution:**

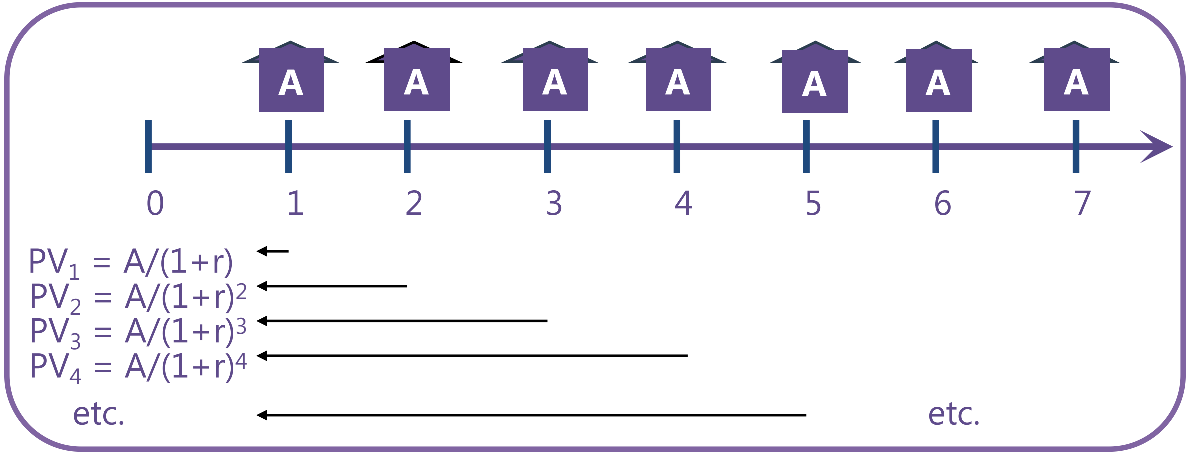
  Input N=30*12=360, I/Y=8/12, PV=100,000, FV=0

  CPT PMT=-733.76
- Calculate the remaining principle after the first payment.Calculate the amount of principle and interest in the first payment.
- **Solution:** Function ([2ND] [PV])

  P1=1，P2=1，BAL=-99,932.9021，PRN=-67.0979，INT=-666,6667

Time Value of Money

- **About perpetuity**
  - **Definition:** A perpetuity is a set of level never-ending sequential cash flows, with the first cash flow occurring one period from now.



$$PV = \frac{A}{1+r} + \frac{A}{(1+r)^2} + \frac{A}{(1+r)^3} + \cdots \qquad (1)$$

$$(1+r)PV = A + \frac{A}{1+r} + \frac{A}{(1+r)^2} + \cdots \qquad (2)$$

$$(2)-(1) \qquad r \times PV = A \Rightarrow PV = \frac{A}{r}$$

Framework

Quantitative Methods

- The Time Value of Money
- **Discounted Cash Flow Applications**
- Statistical Concepts and Market Return
- Probability Concepts
- Common Probability Distributions
- Sampling and Estimation
- Hypothesis Testing
- Technical Analysis

Discounted Cash Flow

➢ **Net Present Value (NPV)**

$$NPV = CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_N}{(1+r)^N} = \sum_{t=0}^{N} \frac{CF_t}{(1+r)^t}$$

$$NPV = 0 = CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \ldots + \frac{CF_N}{(1+IRR)^N} = \sum_{t=0}^{N} \frac{CF_t}{(1+IRR)^t}$$

➢ **Internal Rate of Return (IRR)**

- When NPV= 0, the discount rate.

Example: NPV and IRR of different timing of CF

- Doctor Li invests on a five year-project with 200K initial payment. The projecwill generate cash flows of 50K, 40K, 40K, 50K and 60K at the end of eachyear, respectively. If the market interest rate is 6%, calculate the net presenvalue of the project and internal rate of return of the project.

Example: NPV and IRR

操作	按键	显示
选择现金流键并清零	[CF] [2ND] [CLR WORK]	CF0=0.0000
输入期初投资数值	20[+/-][ENTER]	CF0=-20.0000
输入第一期现金流	[↓] 5 [ENTER]	C01=5.0000
输入第二期现金流	[↓] [↓] 4 [ENTER]	C02=4.0000
输入第三期现金流	[↓] [↓] 4 [ENTER]	C03=4.0000
输入第四期现金流	[↓] [↓] 5 [ENTER]	C04=5.0000
输入第五期现金流	[↓] [↓] 6 [ENTER]	C05=6.0000
选择净现值NPV并输入折现率	[NPV] 6 [ENTER]	I=6.0000
计算净现值NPV	[↓] [CPT]	NPV=0.0795
计算内部收益率IRR	[IRR] [CPT]	IRR=6.1404

Framework

Quantitative Methods

- The Time Value of Money
- Discounted Cash Flow Applications
- **Statistical Concepts and Market Return**
- Probability Concepts
- Common Probability Distributions
- Sampling and Estimation
- Hypothesis Testing
- Technical Analysis

Statistical Concepts and Market Return

- **Statistical concepts**
  - Basic concepts
  - Types of measurement scales
  - Frequency distribution
  - Measures of central tendency
  - Measures of dispersion
  - Skewness
  - Kurtosis

Statistical Concepts and Market Return

- **Descriptive statistics**
  - Descriptive statistics is the study of how data can be summarized effectively to describe the important aspects of large data sets.
  - By consolidating a mass of numerical details, descriptive statistics turns data into information.
- **Inferential statistics**
  - Makes estimations about a large set of data (a population with smaller group of data.

Statistical Concepts and Market Return

- **Definition of Population**: A population is defined as all members of a specified group.
  - Any descriptive measure of a population characteristic is called a **parameter**.
- **Definition of Sample:** A sample is a subset of a population.
  - A **sample statistic** (or statistic) is a quantity computed from or used to describe a sample.

Statistical Concepts and Market Return

- **Types of measurement scales:**
  - Nominal scales
    - ✓ Distinguishing two different things, no order, only has mode
    - ✓ Example: assigning the number 1 to a municipal bond fund, the number 2 to a corporate bond fund.
  - Ordinal scales (>, <)
    - ✓ Making things in order, but the difference are not meaningful
    - ✓ Example: ranking mutual funds based on their five-year cumulative returns, we might assign the number top1 to 10 for the funds performance.
  - Interval scales (>, <, +, -)
    - ✓ Subtract is meaningful
    - ✓ Example: temperature
  - Ratio scales (>, <, +, -, *, /)
    - ✓ With original point
    - ✓ Example: as is money, if we have twice as much money, then we have twice the purchasing power.

- **Relative frequency**
  - The relative frequency of observations in an interval is the number of observations(the absolute frequency) in the interval divided by the total number of observations.
- **Frequency distribution**
  - A frequency distribution is a tabular display of data summarized into a relatively small number of intervals. Frequency distributions permit analyst to evaluate how data are distributed.
- **Cumulative frequency/cumulative relative frequency**
  - The cumulative relative frequency cumulates (adds up) the relative frequencies as we move from the first interval to the last..

Statistical Concepts and Market Return

- Constructing a frequency distribution

Real (Inflation-Adjusted) Equity Returns: Nineteen Major Equity Markets, 1900–2010			
Country	**Arithmetic Mean (%)**	**Country**	**Arithmetic Mean (%)**
Australia	9.1	Netherlands	7.1
Belgium	5.1	New Zealand	7.6
Canada	7.3	Norway	7.2
Denmark	6.9	South Africa	9.5
Finland	9.3	Spain	5.8
France	5.7	Sweden	8.7
Germany	8.1	Switzerland	6.1
Ireland	6.4	United Kingdom	7.2
Italy	6.1	United States	8.3
Japan	8.5		

Statistical Concepts and Market Return

- Constructing a frequency distribution

Frequency Distribution of Average Real Equity Returns				
Return Interval (%)	Absolute Frequency	Relative Frequency (%)	Cumulative Absolute Frequency	Cumulative Relative Frequency (%)
5.0 to 6.0	3	15.79	3	15.79
6.0 to 7.0	4	21.05	7	36.84
7.0 to 8.0	5	26.32	12	63.16
8.0 to 9.0	4	21.05	16	84.21
9.0 to 10	3	15.79	19	100.00

Statistical Concepts and Market Return

- Measures of central tendency: mode, median, mean

- The arithmetic mean $$\overline{X} = \frac{\sum_{i=1}^{N} X_i}{n}$$

- The weighted mean $$\overline{X_W} = \sum_{i=1}^{n} w_i X_i = \left(w_1 X_1 + w_2 X_2 + \ldots + w_n X_n\right)$$

- The geometric mean $$G = \sqrt[N]{X_1 X_2 X_3 \ldots X_N} = \left(\prod_{i=1}^{N} X_i\right)^{1/N}$$

- The harmonic mean $$\overline{X_H} = \frac{n}{\sum_{i=1}^{n} \left(1/X_i\right)}$$

Statistical Concepts and Market Return

- **Quantiles :** Statisticians use the word quantile as the most general term for a value at or below which a stated fraction of the data lie

- **Quartile /Quintile/Deciles/Percentile**

  - Quartiles divide the distribution into quarters,
  - Quintiles into fifths,
  - Deciles into tenths,
  - Percentiles into hundredths.

Statistical Concepts and Market Return

- **Calculation Q= (n+1)y/100**

- **Example :**
- **A series of number : 1 9 11 13 15 21 27 33 35 39 45**
  What is the third quartiles ?

- **Solution:**
  N=11 , Q=(11+1)*75%=9,
  the 9th number is 75%, The third quartiles = 35

Example: Weighted Mean Value

- The asseet allocation of the pension plan and the return of KDR in 2018 shows below, what is the mean return earned by this pension plan?

Asset Allocation for the Pension Plan of The KDR in 2018		
Asset Class	Asset Allocation (Weight)	Asset Class Return (%)
Cash and short-term investments	15	5.5
Bonds	25	8.6
Equities	50	10
Strategic Investments	10	3.9

- **Solution:**

mean portfolio return=0.15*5.5%+0.25*8.6%+0.5*10%+0.1*3.9%=8.365%

- **Absolute dispersion:** is the amount of variability present without comparison to any reference point or benchmark.

Range = maximum value – minimum value

$$MAD = \frac{\sum_{i=1}^{N} \left| X_i - \overline{X} \right|}{n}$$

$$For\ population\ : \sigma^2 = \frac{\sum_{i=1}^{N} (X_i - \mu)^2}{N} \qquad For\ sample\ : s^2 = \frac{\sum_{i=1}^{n} \left(X_i - \overline{X}\right)^2}{n-1}$$

Example: Statistical calculation

- KDR Corp. Annual Stock Price shows below，what is the population variance if the price distribution of KDR is a population? And what if it is a sample?

2013	2014	2015	2016	2017	2018
5	6	7	8	9	10

- **Solution:**

  Use the Statistical Function

Example: Statistical calculation

➢ KDR Corp. Annual Stock Price shows below，what is the population variance if the price distribution of KDR is a population? And what if it is a

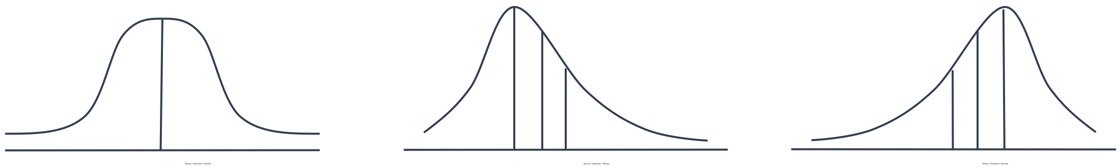
Keys	Result	Explain
【2ND】【7】	X01=0.0000	Invoke the Data Function
【2ND】【CE|C】	X01=0.0000	Clear the Data
5【ENTER】	X01=5.0000	Input the first number
【↓】【↓】6【ENTER】	X02=6.0000	Input the second number
【↓】【↓】7【ENTER】	X03=7.0000	Input the third number
【↓】【↓】8【ENTER】	X04=8.0000	Input the fourth number
【↓】【↓】9【ENTER】	X05=9.0000	Input the fifth number
【↓】【↓】10【ENTER】	X06=10.0000	Input the sixth number

Example: Statistical calculation

➢ KDR Corp. Annual Stock Price shows below，what is the population variance if the price distribution of KDR is a population? And what if it is a

Keys	Result	Explain
【2ND】【8】	LIN	LIN Means there is a linear relation between input data
【↓】	n = 6.0000	The total number of input data is 6
【↓】	$\bar{X}$ = 7.5000	The mean of this 6 numbers is 7.5
【↓】	Sx = 1.8708	If the input is the sample data，the sample standard deviation is 1.8708
【↓】	σx = 1.7078	If the input is the population data, The population standard deviation is 1.7078

Statistical Concepts and Market Return



Mean=Median=Mode
Symmetrical

Mode<Median<Mean
Positive (right) skew

Mean<Median<Mode
Negative(left) skew

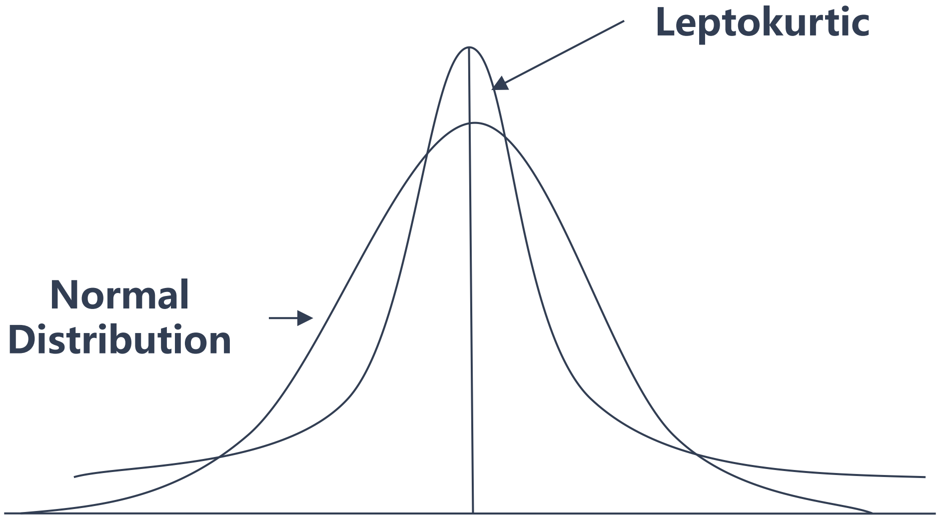
- A distribution that is not symmetrical is called **skewed**.
- **Positive skewed：** Mode<median<mean, having a right fat tail
- **Negative skewed：** Mode>media>mean, having a left fat tail

Statistical Concepts and Market Return

- **Kurtosis** is the statistical measure that tells us when a distribution is more or less peaked than a normal distribution.
- **Leptokurtic vs. platykurtic**
  - A distribution that is more peaked than normal is called **leptokurtic.**
  - A distribution that is less peaked than normal is called **platykurtic**.

	Leptokurtic	Normal Distribution	Platykurtic
Sample kurtosis	>3	=3	<3

Statistical Concepts and Market Return



Framework

Quantitative Methods

- The Time Value of Money
- Discounted Cash Flow Applications
- Statistical Concepts and Market Return
- **Probability Concepts**
- Common Probability Distributions
- Sampling and Estimation
- Hypothesis Testing
- Technical Analysis

Probability Concepts

- **Probability concepts**
  - Two defining properties of probability
  - Multiplication rule and Addition rule
  - Dependent and independent events
  - Expected value

Probability Concepts

- **Basic concepts**
  - **Random variable** a quantity whose value is uncertain. The return on a risky asset is an example of a random variable.
  - Outcomes are the possible values of a random variable.
  - An **event** is a specified set of outcomes.
    - ✓ Mutually exclusive events—can not both happen at the same time.
    - ✓ Exhaustive events—include all possible outcomes.
- **Two defining properties of probability**
  - The probability of any event E is a number between 0 and 1: $0 \leq P(E) \leq 1$.
  - The sum of the probabilities of any set of mutually exclusive and exhaustive events equals 1: $P(E_1)+ P(E_2)+......+ P(E_n)=1$

Probability Concepts

- **Unconditional probability (marginal probability): P(A)**
  - Suppose the question is "What is the probability that the stock earns a return above the risk-free rate (event A)?" The answer is an unconditional probability that can be viewed as the ratio of two quantities.
- **Conditional probability: P(A|B)**
  - Suppose we want to know the probability that the stock earns a return above the risk-free rate (event A), given that the stock earns a positive return (event B). With the words "given that," we are restricting returns to those larger than 0 percent—a new element in contrast to the question that brought forth an unconditional probability. The conditional probability is calculated as the ratio of two quantities.

Probability Concepts

- **Joint probability: P(AB)**
  - **Multiplication rule:**
    - ✓ The joint probability of A and B can be expressed: $P(AB)=P(A|B)\times P(B)$
  - If A and B are mutually exclusive events, then:

    $$P(AB)=P(A|B)=P(B|A)=0$$

- **Probability that at least one of two events will occur:**
  - **Addition rule:** Given events A and B, the probability that A or B occurs, or both occur, is equal to the probability that A occurs, plus the probability that B occurs, minus the probability that both A and B occur.
    - ✓ $P(A \text{ or } B)=P(A)+P(B)-P(AB)$
  - If A and B are mutually exclusive events, then:

    $$P(A \text{ or } B)=P(A)+P(B)$$

Probability Concepts

- **Independent events:**
  - Definition of Independent Events: Two events A and B are independent if and only if $P(A \mid B) = P(A)$ or, equivalently, $P(B \mid A) = P(B)$.
  - Multiplication Rule for Independent Events. When two events are independent, the joint probability of A and B equals the product of the individual probabilities of A and B: $P(AB)=P(A)\times P(B)$
- **Independence and Mutually Exclusive are quite different**
  - If exclusive, must not independence;
  - Cause exclusive means if A occur, B can not occur, A influents B.

Probability Concepts

- **Expected value:** $E(X)=\sum P(X_i)X_i$

$$\mathrm{E(X)}=\sum \mathrm{x_i}{*}\mathrm{P}(x_i)=x_1 * P(x_1)+x_2 * P(x_2)+\cdots+x_n * P(x_n)$$

$$\sigma=\sqrt{\sigma^2} \qquad \sigma^2=\sum_{i=1}^{N} P_i(X_i-EX)^2$$

Framework

Quantitative Methods

- The Time Value of Money
- Discounted Cash Flow Applications
- Statistical Concepts and Market Return
- Probability Concepts
- **Common Probability Distributions**
- Sampling and Estimation
- Hypothesis Testing
- Technical Analysis

Common Probability Distributions

- Common Probability Distributions
  - Properties of discrete distribution and continuous distribution
  - Discrete uniform distribution
  - Continuous uniform distribution
  - Normal distribution

Common Probability Distributions

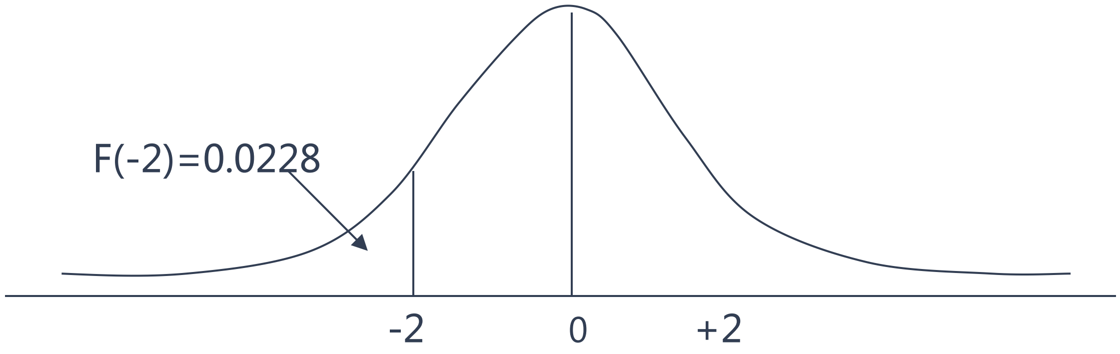
- **Probability Distribution**
  - Describe the probabilities of all the possible outcomes for a random variable.
- **Discrete and continuous random variables**
  - Discrete random variables take on at most a **countable** number of possible outcomes **but do not necessarily to be limited**.
  - Continuous random variables: cannot describe the possible outcomes of a continuous random variable Z with a list $z_1, z_2, \ldots$ because the outcome $(z_1 + z_2)/2$, not in the list, would always be possible.
    - ✓ P (x)=0 even though x can occur.
    - ✓ $P (x_1<X<x_2)$

Common Probability Distributions

- **Probability function: $p(x)=P(X=x)$**
  - For discrete random variables
  - $0 \le p(x) \le 1$
  - $\Sigma p(x)=1$
- **Probability density function (p.d.f) : f(x)**
  - For continuous random variable commonly
- **Cumulative probability function (c.p.f) : F(x)**
  - $F(x)=P(X<=x)$

Common Probability Distributions

➢ **Probability density function**



Common Probability Distributions

- **Discrete uniform**
  - Discrete uniform distribution would be a known, finite number of outcomes equally likely to happen. Every one of n outcomes has equal probability 1/n.
  - For example, rolling a dice will have 6 possible outcomes as X={1,2,3,4,5,6}
    - ✓ In that case, the probability for each outcome is 0.167 [i.e. p(1)=p(2)=p(3)=p(4)=p(5)=p(6)=0.167].

Common Probability Distributions

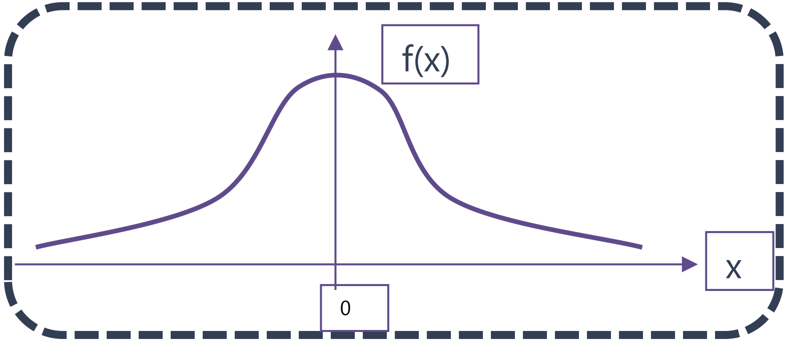
- **Continuous Uniform Distribution**
  - All intervals of the same length on the Continuous Uniform Distribution's support are equally probable.
    - ✓ The support is defined by the two parameters, a and b, which are its minimum and maximum values
- **Properties of Continuous uniform distribution**
  - For all $a \le x_1 < x_2 \le b$

$$P(x_1 \le X \le x_2) = (x_2 - x_1)/(b - a)$$

  - $P(X<a \text{ or } X>b) = 0$

Common Probability Distributions

- **The shape of the density function**

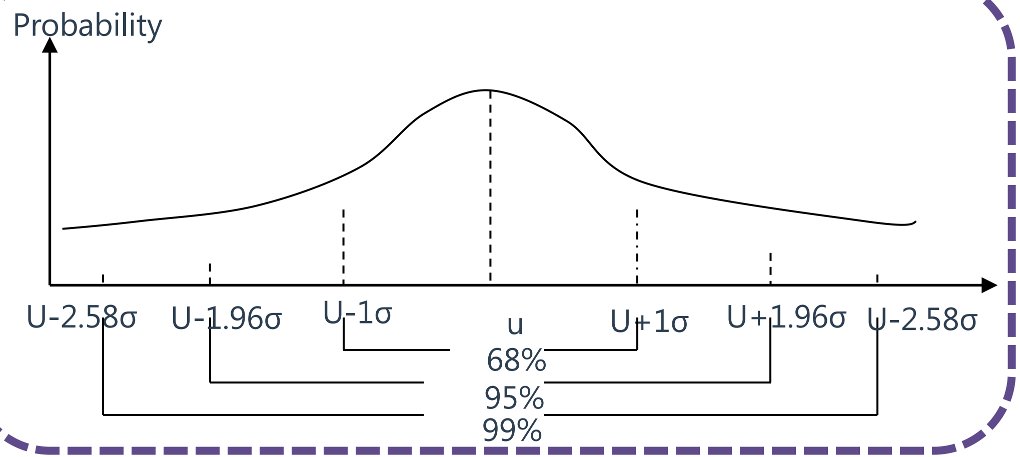


- **Properties:**
  - X~N(μ , σ²)
  - Symmetrical distribution: skewness=0; kurtosis=3
  - A linear combination of random variables these are in normally distribution is also normally distributed.
  - As the values of x gets farther from the mean, the probability density get smaller and smaller but are always positive.

Common Probability Distributions

➢ The confidence intervals

- 68% confidence interval is $[\mu-\sigma,\mu+\sigma]$
- 90% confidence interval is $[\mu-1.65\sigma,\mu+1.65\sigma]$
- 95% confidence interval is $[\mu-1.96\sigma,\mu+1.96\sigma]$
- 99% confidence interval is $[\mu-2.58\sigma,\mu+2.58\sigma]$

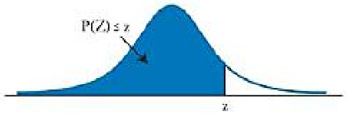


Common Probability Distributions

- **Standard normal distribution**
  - N(0,1) or Z
  - Standardization: if $X \sim N(\mu, \sigma^2)$, then $Z = \dfrac{X-\mu}{\sigma} \sim N(0,1)$
  - Z-table
- $F(-z)=1-F(z)$
- $P(Z>z) = 1 - F(z)$

Common Probability Distributions

Cumulative Z-Table

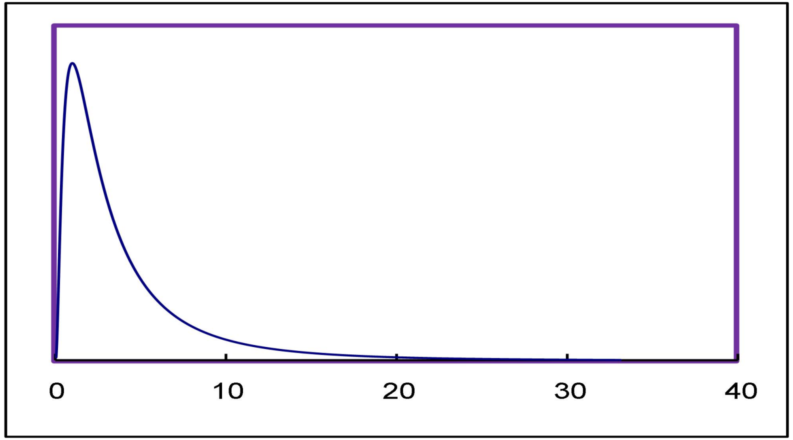


Standard Normal Distribution
$P(Z \leq z) = N(z)$ for $z \geq 0$

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319

Common Probability Distributions

- Definition: If lnX is normal, then X is lognormal, which is used to describe the price of asset;
- Right skewed;
- Bounded from below by zero, so it is useful for modeling asset Prices.



Framework

Quantitative Methods

- The Time Value of Money
- Discounted Cash Flow Applications
- Statistical Concepts and Market Return
- Probability Concepts
- Common Probability Distributions
- **Sampling and Estimation**
- Hypothesis Testing
- Technical Analysis

Sampling and Estimation

- **Sampling and Estimation**
  - Simple random and stratified random sampling
  - Time-series data and cross-sectional data
  - Point estimate and Interval estimate

Sampling and Estimation

- **Sampling and estimation**
  - **Simple random sampling**
    - ✓ A simple random sample is a subset of a larger population created in such a way that each element of the population has an equal probability of being selected to the subset.
    - ✓ The procedure of drawing a sample to satisfy the definition of a simple random sample is called **simple random sampling**.
  - **Stratified random sampling**
    - ✓ In stratified random sampling, the population is divided into subpopulations (strata) based on one or more classification criteria. Simple random samples are then drawn from each stratum in sizes proportional to the relative size of each stratum in the population. These samples are then pooled to form a stratified random sample.
- **Sampling error** is the difference between the observed value of a statistic and the quantity it is intended to estimate.

Sampling and Estimation

➢ **Time-series data**

- are a collection of observations at equally spaced intervals of time.

➢ **Cross-sectional data**

- are a collection of observations at a single point in time.

Time-series data	Cross-sectional data
a collection of data recorded over a period of time	a collection of data taken at a single point of time.

Sampling and Estimation

- **Point estimate**
  - the statistic, computed from sample information, which is used to estimate the population parameter
- **Confidence interval estimate**
  - a range of values constructed from sample data so the parameter occurs within that range at a specified probability.

Framework

Quantitative Methods

- The Time Value of Money
- Discounted Cash Flow Applications
- Statistical Concepts and Market Return
- Probability Concepts
- Common Probability Distributions
- Sampling and Estimation
- **Hypothesis Testing**
- Technical Analysis

Hypothesis Testing

Hypothesis Testing

- The steps in hypothesis testing

Step 1	• Stating null and alternative hypotheses
Step 2	• Identifying the test statistic
Step 3	• Specifying significance level
Step 4	• Stating the decision rule
Step 5	•Collecting the data and caculating the test statistic
Step 6	• Making the statistics decision(reject or not)
Step 7	• Making the economic or investment decision

Framework

Quantitative Methods

- The Time Value of Money
- Discounted Cash Flow Applications
- Statistical Concepts and Market Return
- Probability Concepts
- Common Probability Distributions
- Sampling and Estimation
- Hypothesis Testing
- **Technical Analysis**

Technical Analysis

- **Technical Analysis**
  - Principles of technical analysis
  - Assumptions of technical analysis
  - The differences among technicians, fundamentalists and Efficient market followers
  - Advantages and disadvantages of technical analysis

Technical Analysis

- **Principles:**
  - Prices are the result of the interaction of supply and demand in the real time.
  - The greater the volume of trades, the more impact that market participants will have on price.
  - Trades determine volume and price.
- **Assumptions:**
  - Market prices reflect both rational and irrational investor behavior.
    - ✓ Market trends and patterns reflect the irrational human behavior.
    - ✓ Efficient markets hypothesis dose not hold.
    - ✓ Market trends and patterns repeat themselves and are somewhat predictable.

Technical Analysis

- **The differences among technicians, fundamentalists and Efficient market followers.**
  - Fundamental analysis of a firm seeks to **determine the underlying long-term(intrinsic) value** of an asset by using the financial statements and other information.
  - While technical analysis uses more concrete data, primarily **price and volume data**, and seek to project the level at which a financial instrument will trade.
  - Fundamentalists believe that prices react quickly to changing stock values, while technicians believe that the reaction is slow.
  - Technicians look for changes in supply and demand, while fundamentalists look for changes in value.

Technical Analysis

- **Advantages of technical analysis:**
  - Actual price and volume data is easy to access
  - Technical analysis is objective (although require subjective judgment), while much of the data used in fundamental analysis is subject to assumptions or restatements.
  - It can be applied to the prices of assets that do not produce future cash flows, such as commodities.
  - Fundamental analysis may have the risk of financial statement fraud, while technical analysis doesn`t have.

- **Disadvantage:**
  - In markets that are subject to large outside manipulation, the application of technical analysis is limited.
  - Technical analysis is also limited in illiquid markets, where even modestly sized trades can have an inordinate impact on prices.