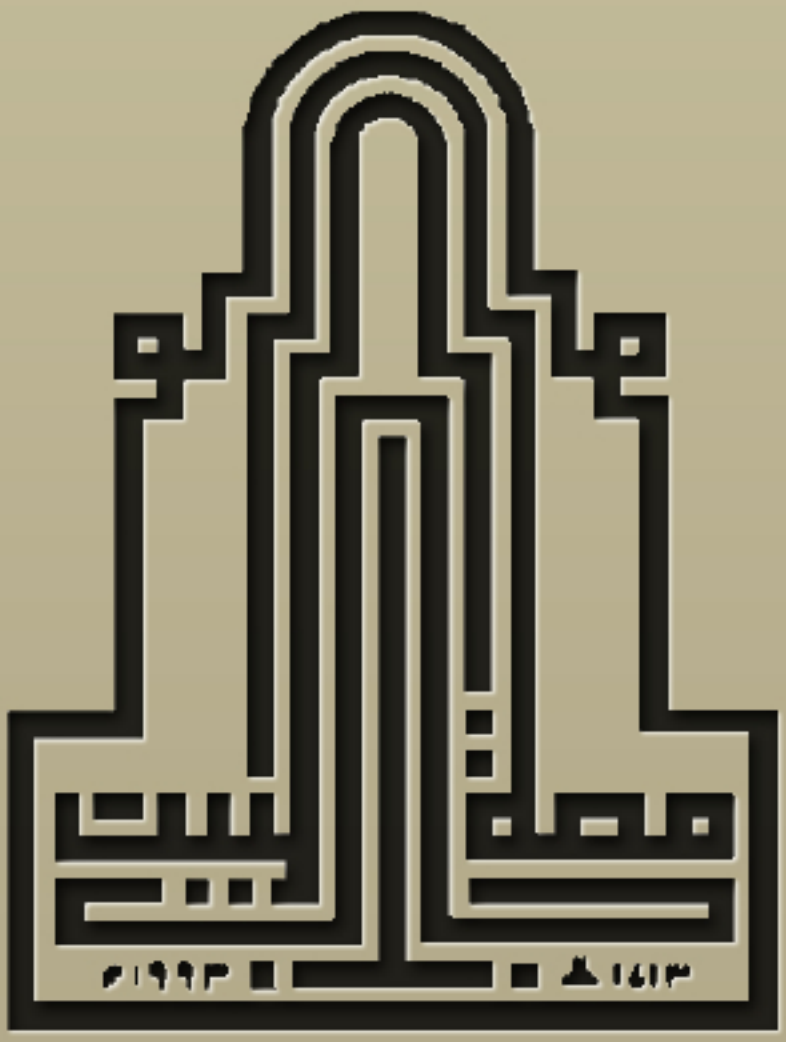
مكتبة

”خُذْ وأعطِي“

الإلكترونية

جامعة آل البيت " كلية الإقتصاد "

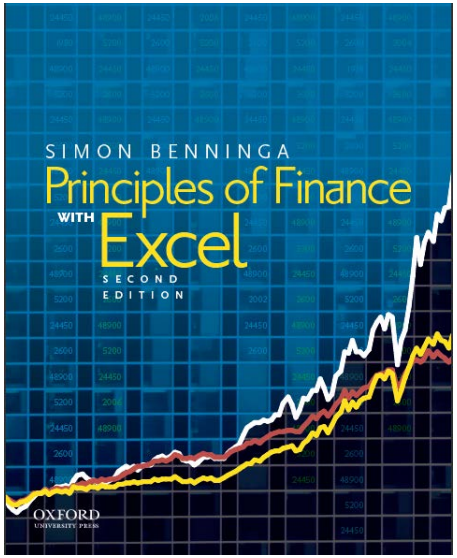
مجموعة طلابية تسعى لتوفير كل ما يلزم طلاب
كلية إدارة المال والاعمال من مواد وشروحات واسئلة بصورة الكترونية



Principles of Finance with Excel, 2nd edition

Instructor materials

Chapter 3
What does it cost?
Understanding IRR



Interest rate often used as a cost

- "My mortgage costs 12.2%"
- I pay 18.1% on unpaid credit card balances

- This chapter:
  - Use IRR as a cost
  - Do this intelligently

EAIR

- "Effective Annual Interest Rate"
- EAIR: IRR calculated on annual basis, taking account of all relevant costs
- Not to be confused with "annual percentage rate" (APR).
  - APR is a confusing concept with no well-defined meaning

Be careful! Example 1

- You're considering a loan from either West Hampton Bank or East Hampton Bank
- West Hampton charges 8%
- East Hampton charges 6%. BUT they have a "loan initiation charge" of 4%
- Which is cheaper?

West Hampton is cheaper

	A	B	C	D
1	**CHEAPER LOAN: WEST HAMPTON OR EAST HAMPTON?**			
2		**West Hampton**	**East Hampton**	
3	Quoted interest rate	8%	6%	
4	Initial charges	0%	4%	
5	Amount borrowed to get $100 today	100.00	104.17	<-- =100/(1-C4)
6				
7	**Date**	**Cash flow**	**Cash flow**	
8	Date 1, get loan	100.00	100.00	
9	Date 2, pay it back	-108.00	-110.42	<-- =-C5*(1+C3)
10	Effective annual interest rate, EAIR	8.00%	10.42%	<-- =IRR(C8:C9)

Be careful! Example 2

- Loan Shark Inc. charges 14.4% interest *on a monthly basis*. When you ask them: this means 14.4%/12 = 1.2% per month.
- Is Loan Shark cheaper than your bank, which charges 15% annually?

Loan Shark is more expensive!

	A	B	C	D
1	**THE BANK OR LOAN SHARK?**			
2		**Bank**	**Loan Shark**	
3	Quoted interest rate	15.0%	14.4%	
4	Borrow today	1,000.00	1,000.00	
5	Repay in one year	-1,150.00	-1,153.89	<-- =-C4*(1+C3/12)^12
6	Effective annual interest rate, EAIR	15.00%	15.39%	<-- =-C5/C4-1
7				
8	**A second way to compute the EAIR**			
9	Monthly interest rate		1.20%	<-- =C3/12
10	EAIR Annualized monthly rate		15.39%	<-- =(1+C9)^12-1

Be careful! Example 3

- You're buying a Junkmobile for $2,000.
- You don't have any money.
- Dealer offers two options:
  - Pay cash, get 15% discount
  - "Zero percent financing": Pay nothing today, pay full price of $2,000 in one year
- Uncle Frank will loan you money for 10%.

	A	B	C	D	E
1	**FINANCING THE JUNKMOBILE**				
2	**Year**	**Pay cash**	**Dealer's "0% financing"**	**Differential cash flow**	
3	0	-1,700	0	1,700	<-- =C3-B3
4	1		-2,000	-2,000	<-- =C4-B4
5					
6	Effective annual interest rate (EAIR) charged by dealer			17.65%	<-- =IRR(D3:D4)

Dealer's "0% financing" is really 17.65%! You're better off paying cash to the dealer and borrowing the $1,700 from Uncle Frank at 10%.

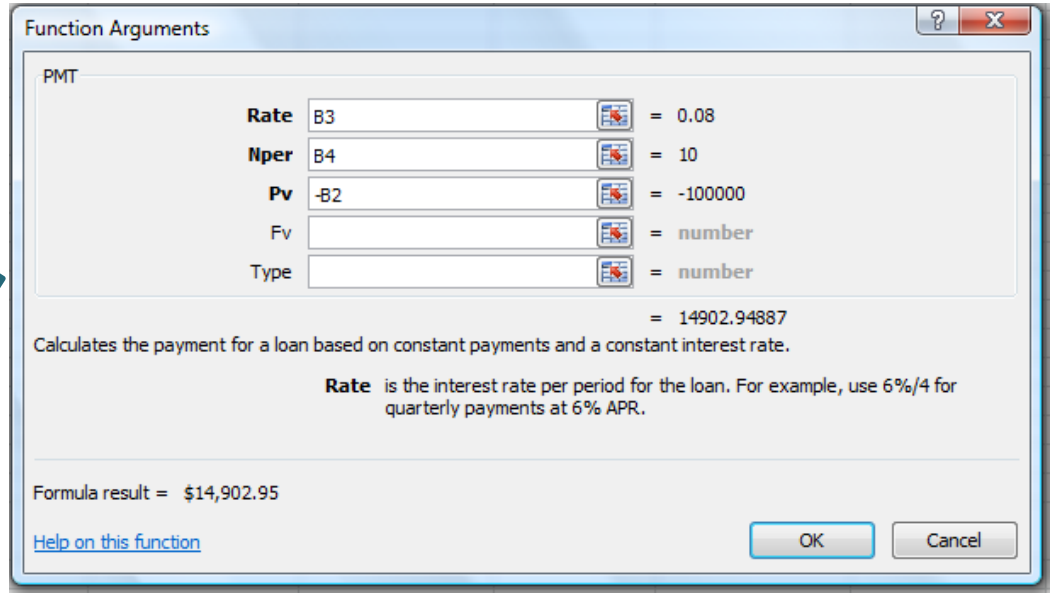
	A	B	C	D
9	**Year**	**Borrow from Uncle Frank**		
10	0	1,700		
11	1	-1,870		
12	Effective annual interest rate (EAIR) charged by Uncle Frank	10.00%	<-- =IRR(B10:B11)	

Cost of a mortgage

- Simple mortgage:
  - Borrow $100,000 for 10 years, 8% interest
  - Annual payments
- **PMT** will compute the payment

Mortgage (continued)

	A	B	C
1	**A SIMPLE MORTGAGE**		
2	Mortgage principal	100,000	
3	Interest rate	8%	
4	Mortgage term (years)	10	
5	Annual payment	$14,902.95	<-- =PMT(B3,B4,-B2)
6			
7	**Year**	**Mortgage cash flow**	
8	0	100,000.00	
9	1	-14,902.95	<-- =-B5
10	2	-14,902.95	
11	3	-14,902.95	
12	4	-14,902.95	
13	5	-14,902.95	
14	6	-14,902.95	
15	7	-14,902.95	
16	8	-14,902.95	
17	9	-14,902.95	
18	10	-14,902.95	
19			
20	Effective annual interest rate (EAIR)	8.00%	<-- =IRR(B8:B18)



PMT function: We put in **PV** as a negative number in order to get a positive mortgage payment. (This was discussed in Chapter 2.)

Mortgage with points

- Same story as before: $100,000 mortgage, 10 years, 8% interest.
- But: Bank charges “1.5 points.” This means they give you only $98,500, but charge you as if you’ve borrowed $100,000.

Computing EAIR on mortgage with points

	A	B	C
1	**A MORTGAGE WITH POINTS**		
2	Mortgage principal	100,000	
3	"Points"	1.50%	
4	Quoted interest	8.00%	
5	Mortgage term (years)	10	
6	Annual payment	$14,902.95	<-- =PMT(B4,B5,-B2)
7			
8	**Year**	**Mortgage cash flow**	
9	0	98,500.00	<-- =B2*(1-B3)
10	1	-14,902.95	<-- =-B6
11	2	-14,902.95	
12	3	-14,902.95	
13	4	-14,902.95	
14	5	-14,902.95	
15	6	-14,902.95	
16	7	-14,902.95	
17	8	-14,902.95	
18	9	-14,902.95	
19	10	-14,902.95	
20			
21	Effective annual interest rate (EAIR)	8.34%	<-- =IRR(B9:B19)

Mortgage amortization table

	A	B	C	D	E	F
21	Effective annual interest rate (EAIR)	8.34%	<-- =IRR(B9:B19)			
22						
23	**MORTGAGE AMORTIZATION TABLE**					
24	**Year**	**Mortgage principal at beginning of year**	**Payment at end of year**	**Part of payment that is interest (expense for taxes!)**	**Part of payment that is repayment of principal (not an expense for tax purposes)**	
25	1	98,500.00	$14,902.95	$8,211.41	6,691.54	<-- =C25-D25
26	2	91,808.46	$14,902.95	$7,653.58	7,249.37	
27	3	84,559.09	$14,902.95	$7,049.23	7,853.71	
28	4	76,705.38	$14,902.95	$6,394.51	8,508.44	
29	5	68,196.94	$14,902.95	$5,685.21	9,217.74	
30	6	58,979.20	$14,902.95	$4,916.78	9,986.17	
31	7	48,993.03	$14,902.95	$4,084.28	10,818.66	
32	8	38,174.37	$14,902.95	$3,182.39	11,720.56	
33	9	26,453.81	$14,902.95	$2,205.31	12,697.64	
34	10	13,756.17	$14,902.95	$1,146.78	13,756.17	
35						
36	=B25-E25		=B21*B25			

The table splits each payment of $14,902.95 into interest and return of principal.

- Interest = 8.34%*Principal at beginning of year
- Repayment of principal = Payment ($14,902.95) – Interest

You can see that at 10 years the mortgage is repaid.

Longer-term mortgages

- 30-year mortgage, $100,000 principal
- 8% interest, computed monthly (meaning 8%/12 = 0.6667% per month)
- Points: 1; “origination fee” = 0.5%
- Meaning: You get $98,500, but are charged as if you borrowed $100,000

30-year mortgage

	A	B	C
1	**30-YEAR MORTGAGE With points and origination fee**		
2	Loan principal	100,000.00	
3	Loan term (years)	30	
4	Quoted interest rate	8%	
5	Discount points	1	
6	Origination fee	0.5%	
7			
8	Initial amount of loan, net of fees	98,500.00	<-- =B2*(1-B5/100-B6)
9	Monthly repayment	733.76	<-- =PMT(B4/12,B3*12,-B2)
10			
11	**Calculating the EAIR**		
12	Monthly interest rate	0.6800%	<-- =RATE(B3*12,B9,-B8)
13	Effective annual interest rate (EAIR)	8.4721%	<-- =(1+B12)^12-1

Note use of **Rate** to compute EAIR (next slide).

Lease vs purchase

- Common financial problem
- In this simple example:
  - Buy computer for $4,000
  - Lease it for 3 years for $1,500 annually.
    - Catch: You pay $1,500 now and $1,500 at the end of years 1, 2, 3
- To compute the cost of the lease, use the differential cash flows (next slide)
    - The differential cash flows show that lease is like borrowing $2,500 with payments of $1,500 in years 1, 2, 3

	A	B	C	D	E
1	**BASIC LEASE VERSUS PURCHASE THE DIFFERENTIAL CASH FLOWS**				
2	Asset cost	4,000			
3	Annual lease payment	1,500			
4	Bank rate	15%			
5					
6	**Year**	**Purchase cash flow**	**Lease cash flow**	**Differential cash flow**	
7	0	4,000	1,500	2,500	<-- =B7-C7
8	1		1,500	-1,500	<-- =B8-C8
9	2		1,500	-1,500	<-- =B9-C9
10	3		1,500	-1,500	<-- =B10-C10
11					
12	IRR of differential cash flows			36.31%	<-- =IRR(D7:D10)
13	Lease or purchase?			purchase	<-- =IF(D12>B4,"purchase","lease")
14					
15	Explanation: The lease is like a loan--you save 2,500 in year 0 and pay back 1,500 in each of years 1-3. The IRR of this "loan" is 36.31%.				

The example assumes that you can borrow at 15% from the bank. Cell D13 decides lease or purchase depending on which is cheaper.

	A	B	C	D
17	**What if you borrowed $2,500 from the bank?**			
18	**Year**	**Money saved by leasing**		**Same amount from bank**
19	0	2,500		2,500.00
20	1	-1,500		-1,094.94 <-- =PMT(B4,3,D19)
21	2	-1,500		-1,094.94
22	3	-1,500		-1,094.94

Payments on bank loan are cheaper, same amount borrowed!

Auto lease

Advanced topic: More frequent compounding

THE FOLLOWING IS TAKEN FROM THE WEBSITE OF CITIBANK (South Dakota). It describes the interest rate (APR = "annual percentage rate") on credit cards.

Variable APRs Based on Prime. If any APR is based on the U.S. Prime Rate ("Prime Rate"), the APR will equal the Prime Rate plus an additional amount. If the Prime Rate increases, it will cause the APR to increase. If the Prime Rate decreases, it will cause the APR to decrease. For each billing period we use the Prime Rate published in *The Wall Street Journal* two business days before the Statement Closing Date. If the Prime Rate causes an APR to change, we put the new APR into effect as of the first day of the billing period for which we calculate the APR. We apply the new APR to any existing balances, subject to any promotional rate that may apply. If *The Wall Street Journal* does not publish the Prime Rate, we will use a similar published rate.

Very difficult to understand!

https://www.accountonline.com/ACQ/DisplayPage?docId=InitDisclosurePop&sc=6UJZQ6701000MDM290W&app=UNSOL&siteId=AC&langId=EN&BUS_TYP_CD=CONSUMER&DOWNSELL_LEVEL=0&BALCON_SC=&B=M&DOWNSELL_BRANDS=&t=&uc=

Citibank goes on to say

- **APR for Purchases.** There is a standard purchase APR. It equals the Prime Rate plus 9.74%. As of 09/01/2010 this APR is 12.99%. This APR equals a daily periodic rate of 0.0356%.
- **APR for Cash Advances.** There is a standard cash advance APR. It equals the Prime Rate plus 21.99%. As of 09/01/2010, this APR is 25.24%. This APR equals a daily periodic rate of 0.0692%.

What does this mean?

	A	B	C	D
1	**HOW DOES CITIBANK COMPUTE THE INTEREST RATE ON CREDIT CARDS?**			
2		**Purchases**	**Cash advances**	
3	Prime rate	3.25%	3.25%	
4	Additional	9.74%	21.99%	
5	APR	12.990%	25.240%	
6	Daily	0.0356%	0.0692%	<-- =C5/365
7	EAIR: Effective annual interest rate	13.869%	28.700%	<-- =(1+C6)^365-1

The APR <u>understates dramatically</u> the actual interest cost. The effective annual interest rate on purchases is 13.869% and not the APR of 12.99%; on cash advances 28.7% and not the APR of 25.24%. Shame on you Citibank!

What is the effective annual interest rate (EAIR)

$$EAIR = \left(1 + \frac{25.40\%}{365}\right)^{365} - 1$$

This is very close to $e^{25.40\%} - 1$

	A	B	C	D
2		**Purchases**	**Cash advances**	
3	Prime rate	3.25%	3.25%	
4	Additional	9.74%	21.99%	
5	APR	12.990%	25.240%	
6	Daily	0.0356%	0.0692%	<-- =C5/365
7	EAIR: Effective annual interest rate	13.869%	28.700%	<-- =(1+C6)^365-1
8				
9	Using continuous compounding to compute the EAIR (advanced topic)			
10				
11		13.871%	28.711%	<-- =EXP(C5)-1

Continuous compounding can simplify the computations of EAIR when the compounding periods are very short. In this example: daily compounding.