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Excel Sheet

Problem 2

Interest Rate		10%
Periods		10
Payment	$	100

Calculated with 'Brute Force method' in Excel

Period	Payment	Discount Factor	PV of Payment	**Total PV**
1	$ 100	0,90909	$ 90,90909	$ 614,457
2	$ 100	0,82645	$ 82,64463	
3	$ 100	0,75131	$ 75,13148	
4	$ 100	0,68301	$ 68,30135	
5	$ 100	0,62092	$ 62,09213	
6	$ 100	0,56447	$ 56,44739	
7	$ 100	0,51316	$ 51,31581	
8	$ 100	0,46651	$ 46,65074	
9	$ 100	0,42410	$ 42,40976	
10	$ 100	0,38554	$ 38,55433	

Calculated with 'Present Value' formula in Excel

Total PV	$	-614,457	***<– negative as this is the cash-outflow we are willing to have for this payment stream***

Problem 3

	(i)	(ii)	(iii)	(iv)
Payment	$0	$0	$80.000	$175.000
Periods	0	4	Infinite	10
Future Value	$1.200.000	$1.600.000	-	$0

Value with 5% interest rate

Interest rate 5%

(i)	(ii)	(iii)	(iv)
$ 1.200.000,00	$ 1.316.323,96	$ 1.600.000,00	$ 1.351.303,61

Value with 9% interest rate

Interest rate 9%

(i)	(ii)	(iii)	(iv)
$ 1.200.000,00	$ 1.133.480,34	$ 888.888,89	$ 1.123.090,10

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Problem 4

Calculate the value of a $1,000 bond with 5% coupon rate

Face value	$1.000
Coupon rate	5%
Payment pr year	2
Periods	10

Period	Spot rate	Discount Factor	Payment	Present Value	**Price**
1	2%	0,99010	$25	$24,75248	**$968,073**
2	3%	0,97066	$25	$24,26654	
3	3,67%	0,94691	$25	$23,67276	
4	4,17%	0,92077	$25	$23,01931	
5	4,57%	0,89318	$25	$22,32956	
6	4,90%	0,86482	$25	$21,62062	
7	5,19%	0,83583	$25	$20,89569	
8	5,44%	0,80679	$25	$20,16972	
9	5,66%	0,77790	$25	$19,44740	
10	5,86%	0,74917	$1.025	$767,89906	

Calculate the YTM

Brute force with GoalSeek

YTM	5,74%

Period	Spot rate	Discount Factor	Payment	Present Value	**Difference**
1	5,74%	0,97208	$25	$24,30208	**$0,000**
2	5,74%	0,94495	$25	$23,62365	
3	5,74%	0,91857	$25	$22,96416	
4	5,74%	0,89292	$25	$22,32308	
5	5,74%	0,86800	$25	$21,69989	
6	5,74%	0,84376	$25	$21,09410	
7	5,74%	0,82021	$25	$20,50523	
8	5,74%	0,79731	$25	$19,93279	
9	5,74%	0,77505	$25	$19,37633	
10	5,74%	0,75342	$1.025	$772,25193	

Using =RATE(period;payment;price;future value)*periods

YTM	**5,74%**

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Calculate the Macualay Duration

m	2
R	5,74%
P	$968,073

t	CF		Value of Sum	Multiplier	D
1	$	25	0,025	0,500	4,475
2	$	25	0,049		
3	$	25	0,071		
4	$	25	0,092		
5	$	25	0,112		
6	$	25	0,131		
7	$	25	0,148		
8	$	25	0,165		
9	$	25	0,180		
10	$	1.025	7,977		

Calculate the Duration

D* with formula	4,350
D* with MDURAT	4,350

Calculate the Convexity

t	CF		Value of Sum	Multiplier	C
1	$	25	0,050	0,236	22,383
2	$	25	0,146		
3	$	25	0,285		
4	$	25	0,461		
5	$	25	0,672		
6	$	25	0,915		
7	$	25	1,186		
8	$	25	1,482		
9	$	25	1,801		
10	$	1.025	87,749		

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Recalculate the Price 100 basis points higher

Delta-% in spot 1%

Period	Spot rate	Discount Factor	Payment	Present Value	**Price**
1	3%	0,98522	$25	$24,63054	**$927,140**
2	4%	0,96117	$25	$24,02922	
3	4,67%	0,93310	$25	$23,32746	
4	5,17%	0,90295	$25	$22,57379	
5	5,57%	0,87167	$25	$21,79171	
6	5,90%	0,83993	$25	$20,99819	
7	6,19%	0,80786	$25	$20,19653	
8	6,44%	0,77605	$25	$19,40123	
9	6,66%	0,74467	$25	$18,61668	
10	6,86%	0,71373	$1.025	$731,57460	

Recalculate the Price 100 basis points lower

Delta-% in spot -1%

Period	Spot rate	Discount Factor	Payment	Present Value	**Price**
1	1%	0,99502	$25	$24,87562	**$1.011,164**
2	2%	0,98030	$25	$24,50740	
3	2,67%	0,96100	$25	$24,02490	
4	3,17%	0,93903	$25	$23,47587	
5	3,57%	0,91534	$25	$22,88343	
6	3,90%	0,89059	$25	$22,26469	
7	4,19%	0,86491	$25	$21,62264	
8	4,44%	0,83891	$25	$20,97263	
9	4,66%	0,81278	$25	$20,31951	
10	4,86%	0,78655	$1.025	$806,21735	

Calculate the Effective Duration

D_eff 4,340

Calculate prices using the modified duration

			Delta price
Delta r = 1%	$	925,959	$ -1,181
Delta r = -1%	$	1.010,187	$ -0,977

Calculate prices using the modified duration and convexity-based approximation

			Delta price
Delta r = 1%	$	927,043	$ -0,097
Delta r = -1%	$	1.011,271	$ 0,107

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Recalculate the Price 25 basis points higher

Delta-% in spot 0,25%

Period	Spot rate	Discount Factor	Payment	Present Value	**Price**
1	2%	0,98888	$25	$24,72188	**$957,642**
2	3%	0,96828	$25	$24,20688	
3	3,92%	0,94343	$25	$23,58580	
4	4,42%	0,91628	$25	$22,90691	
5	4,82%	0,88774	$25	$22,19362	
6	5,15%	0,85852	$25	$21,46302	
7	5,44%	0,82873	$25	$20,71834	
8	5,69%	0,79898	$25	$19,97444	
9	5,91%	0,76944	$25	$19,23592	
10	6,11%	0,74013	$1.025	$758,63555	

Recalculate the Price 25 basis points lower

Delta-% in spot -0,25%

Period	Spot rate	Discount Factor	Payment	Present Value	**Price**
1	2%	0,99133	$25	$24,78315	**$978,639**
2	3%	0,97306	$25	$24,32642	
3	3,42%	0,95041	$25	$23,76014	
4	3,92%	0,92530	$25	$23,13240	
5	4,32%	0,89866	$25	$22,46651	
6	4,65%	0,87118	$25	$21,77958	
7	4,94%	0,84299	$25	$21,07477	
8	5,19%	0,81469	$25	$20,36716	
9	5,41%	0,78646	$25	$19,66146	
10	5,61%	0,75833	$1.025	$777,28716	

Calculate the Effective Duration

D_eff 4,338

Calculate prices using the modified duration

			Delta price
Delta r = 0,25%	$ 957,545	$	-0,098
Delta r = -0,25%	$ 978,602	$	-0,037

Calculate prices using the modified duration and convexity-based approximation

			Delta price
Delta r = 0,25%	$ 957,612	$	-0,030
Delta r = -0,25%	$ 978,669	$	0,031