## ECE 333 Green Electric Energy - Quiz 5 Solutions

Tuesday, November 14, 2017

### **Duration: 20 minutes**

Name:	last 4 digits of your UIN:
	last + uigits of your Ont.

# Closed book, closed notes, cell phones are not allowed. Show all you work and always indicate the units, as appropriate.

### Problem 1 [100 points]:

In this problem, you will evaluate the economics of a *PV* system installation project that has a lifetime of 20 years. The 20-kWPV system on a commercial site incurs an investment of \$ 70,000. The *PV* system reduces the annual load consumption by 200 *MWh*, and the peak demand by 35 *kW*. The electricity costs are 80 \$/MWh and the demand charges are 10 \$/kW- *year*.

**a. [50 points] Calculate** the *IRR* for the project. (Ignore the escalation of electricity prices and demand charges).

### Solution:

The annual savings are:

- energy savings: (200 *MWh*)(80 *\$/MWh*) = *\$* 16,000
- peak demand savings :  $(35 \ kW)(10 \ s/kW-year) = \ s \ 350$

•

Total savings = \$ 16,000 + \$ 350 = \$ 16,350

The *IRR* is the value of d' that results in

$$0 = -70,000 + 16,350 \ \frac{1 - (\beta')^{20}}{d'}$$

$$\frac{1 - (\beta')^{20}}{d'} = 4.28$$

The table look-up produces d' = 23 %.

**b.** [50 points] Consider that the electricity costs and the demand charges escalate at an annual rate of j = 4 %. Calculate the combined *IRR*.

Solution:

$$(1+d) = (1+j)(1+d')$$
$$(1+d) = (1.04)(1.23)$$
$$(1+d) = 1.28$$
$$d = 0.28$$

So, the combined IRR is 28 %

Life (years)	9%	11%	13%	15%	17%	19%	21%	23%	25%	27%	29%	31%	33%	35%	37%	39%
1	0.92	0.90	0.88	0.87	0.85	0.84	0.83	0.81	0.80	0.79	0.78	0.76	0.75	0.74	0.73	0.72
2	1.76	1.71	1.67	1.63	1.59	1.55	1.51	1.47	1.44	1.41	1.38	1.35	1.32	1.29	1.26	1.24
3	2.53	2.44	2.36	2.28	2.21	2.14	2.07	2.01	1.95	1.90	1.84	1.79	1.74	1.70	1.65	1.61
4	3.24	3.10	2.97	2.85	2.74	2.64	2.54	2.45	2.36	2.28	2.20	2.13	2.06	2.00	1.94	1.88
5	3.89	3.70	3.52	3.35	3.20	3.06	2.93	2.80	2.69	2.58	2.48	2.39	2.30	2.22	2.14	2.07
6	4.49	4.23	4.00	3.78	3.59	3.41	3.24	3.09	2.95	2.82	2.70	2.59	2.48	2.39	2.29	2.21
7	5.03	4.71	4.42	4.16	3.92	3.71	3.51	3.33	3.16	3.01	2.87	2.74	2.62	2.51	2.40	2.31
8	5.53	5.15	4.80	4.49	4.21	3.95	3.73	3.52	3.33	3.16	3.00	2.85	2.72	2.60	2.48	2.38
9	6.00	5.54	5.13	4.77	4.45	4.16	3.91	3.67	3.46	3.27	3.10	2.94	2.80	2.67	2.54	2.43
10	6.42	5.89	5.43	5.02	4.66	4.34	4.05	3.80	3.57	3.36	3.18	3.01	2.86	2.72	2.59	2.47
15	8.06	7.19	6.46	5.85	5.32	4.88	4.49	4.15	3.86	3.60	3.37	3.17	2.99	2.83	2.68	2.55
20	9.13	7.96	7.02	6.26	5.63	5.10	4.66	4.28	3.95	3.67	3.43	3.21	3.02	2.85	2.70	2.56
25	9.82	8.42	7.33	6.46	5.77	5.20	4.72	4.32	3.98	3.69	3.44	3.22	3.03	2.86	2.70	2.56
30	10.27	8.69	7.50	6.57	5.83	5.23	4.75	4.34	4.00	3.70	3.45	3.22	3.03	2.86	2.70	2.56
	-		-						-	-						