

## Exercises for seminar no. 6

### (2) revised

Consider a real investment project lasting for one period only, with deterministic costs,  $B = 1200$ , producing a deterministic quantity,  $A = 100$ , of some commodity. The output price is  $P_t$ , which has uncertain future values. Revenue and costs of the project appear within the same time period.

At  $t = 0$  there are traded forward contracts on the commodity for delivery at  $t = 1$ . These have a forward price,  $F_{01} = 19$ . Today's price is  $P_0 = 18$ . The output price follows a GBM with  $\sigma = 0.29$ . The risk free interest rate factor is  $e^r = 1.125$ .

Find the value of having a claim to the project opportunity at  $t = 0$  under three alternative assumptions:

- 2(a) The project is undertaken at  $t = 0$ .
- 2(b) One commits at  $t = 0$  to undertaking the project at  $t = 1$ .
- 2(c) After  $P_1$  is known, one will have the choice of undertaking the project at  $t = 1$  or never.

For part (c), show that the cash flow from the project at  $t = 1$ , as seen from  $t = 0$ , is equal to the cash flow from an option (or a number of equal options), as a function of the uncertain output price  $P_t$ . Try to find the valuation at  $t = 0$  of such a cash flow.

(The Black-Scholes-Merton formula is not quite what you need for this, but you may use it anyhow.)

(The numbers which were part of the previous version of this problem,  $N(1.73)$  and  $N(1.44)$ , will not be useful if you use the standard Black-Scholes-Merton version.)