4. You work for an oil company which has discovered a large new oil field. Your job is to decide whether to develop the field, and if so, which of two alternative oil rigs to use to pump the oil. The main source of uncertainty is the amount of oil in the field. With probability 20%, this is 6 million barrels, with probability 50%, it is 10 million, and with probability 30%, it is 20 million. You must pay for the rig now and production will begin in Year 1 and last until the field is exhausted. Rig A costs $50 million while Rig B costs $150 million, but it allows you to pump oil faster. The following table shows what your annual cashflow would be in each scenario and with each rig, and the duration i.e. how many years that annual cashflow would last.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Rig A |  |  |  | Rig B |  |
|  | Scenario |  |  |  | Scenario |  |  |
| Probability | 20% | 50% | 30% |  | 20% | 50% | 30% |
| Cashflow | 34 | 34 | 34 |  | 71 | 71 | 71 |
| Duration | 6 | 10 | 20 |  | 3 | 5 | 10 |

The discount rate is 10%. (Hint: ignore taxes and anything else not mentioned.)

a) (*16 points*) Suppose you have no way of resolving your uncertainty about the size of the field before making a decision. **Should you install Rig A, Rig B, or neither?**

**Answer:** Install Rig A since it has a higher expected net present value.

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b) (*16 points*) Now suppose that you can do further testing in order to reveal the exact size of the oil field, i.e. find out what scenario is true before installing a rig. This test would not delay installation of the rig or the beginning of production, but it would cost money. In each scenario of oil field size, once you have done the test and know the size, would you develop the field, and which rig would you install? **What is the value to you of doing the test?** Draw the decision tree. Solve it, and then write a sentence or two giving the optimal decision and the value of the test.

**Answer:** Install Rig A if field size 6 million or 10 million barrels (scenario 1 or 2) since NPV (A) > NPV (B), install Rig B if the field size is 20 million barrels (scenario 3).

**E [NPV]** = $98.08 \* 20% + $158.92 \* 50% + $286.26 \* 30%

**E [NPV]** = $184.95

The value of the test is $184.95 – $170.91 = **$14.04** million