7.12 Exercises

1. The marginal benefits of water for a given population in year 0 is given by $mb = 20 - 3w$. If the annual population growth rate is 1 percent and population growth is the only shifter of demand, what is the marginal benefit function in year 5? What is the year 5 benefit of increasing water supply from 6 to 7 units?

2. Suppose that a new dam is proposed to alleviate an urban scarcity problem. No benefits other than water supply are conveyed by the project. The dam will capture an additional five thousand acre-feet of water every year for a current (discounted and summed) cost of $2,000 per acre-foot. That is, the present value of project costs is $10 million. Suppose that discounted and summed project benefits measured as the areas under users' MNB curves are $20 million. If state law permitted the transfer of water rights, it is expected that existing rights would trade for $1,000 per acre-foot. Unfortunately, state law does not allow such exchanges to occur. Should this dam be built? Would you modify your answer if this dam scenario is repeated throughout the state?

3. If the present value of a project's construction costs is $400, what alternative split(s) of these costs between the two beneficiaries can be economically justified? The gross benefits received by users 1 and 2 are $350 and $150, respectively. Their separable costs are $50 and $70, respectively. Provide a full explanation.

4. The chairman of a regional water agency maintains that a proposed, publicly funded water canal is justified, based on agency analysis. The canal has a present value of costs amounting to $50 million. Absent the canal, the chair says it will cost $100 million to obtain the same water supply increment using the next cheapest option. Moreover, absent both strategies, business activity in the region cannot grow by the forecast $500 million in total annual sales. Has the agency presented a compelling analysis? Why/not?

5. Kettle Irrigation District (KID), a nonprofit cooperative, wants to assess the economic merits of a canal rehabilitation project promising to reduce conveyance leakage. Currently, KID withdraws 50,000 acre-feet of river water in a typical year so as to deliver 20,000 acre-feet to farm gates. Although this indicates an average conveyance loss of 1.5 af for every 1.0 af delivered, engineers believe that the marginal conveyance loss is much lower (0.2 af lost per 1.0 af delivered). For the sum of $3,600,000 divided equally over three years, a private contractor will refurbish KID's canals during three consecutive winter off-seasons. The worst canals will be addressed first. Considered independently, the three phases are projected to reduce leakage by 5,000, 4,000, and 3,000 acre-feet, respectively. These accomplishments will have finite lives, however. Each is expected to degrade linearly following each season, so that each repaired canal will return to its present condition after ten years of service. For example, the first phase will reduce leakage by 5,000 af during its first year of operation, but it will save only 4,500 af during its second year. After ten years, conveyance losses will not worsen further. Using a 6 percent discount rate and a twenty-year time horizon, assess this project and make recommendations after applying the following information to evaluate benefits. The district estimates its water production costs at $5 per acre-foot (mostly for energy), but farmers are charged $7 for every acre-foot they receive. KID has an ample water supply during most years, but during one year out of five there are weather-caused shortages.

During these dry years, KID allows trading among its farmers, and these lease prices generally hover around $10 per af (excluding KID's delivery charge). KID has never allowed direct trading between its farmers and nonmembers, but there is an active water market in the basin. During most years, regional lease prices approximate $50/af, but they triple during the one out of five dry years.

6. A donor-funded Environmental Organization (EO) and a State Agency (SA) are in dispute, and the dispute has moved to the courtroom where testimony is to be heard by a panel of judges. The agency has been supporting two large interbasin water transfer projects by offering to pay 20% of their costs. Projects must pass SA's NPV test prior to winning support. SA's prior analysis found a good NPV measure using a 10% real discount rate and is therefore supporting both projects. EO argues that SA did not discharge its responsibilities properly in two areas: environmental incommensurables are at stake and the selected discount rate underweights future economic development losses in the areas of origin. Choose a side and provide that legal team with a list and explanation of the economic points you would emphasize for their case.