

Data of the power generation problem is contained in Table below.

Power Gen Inc: Electricity Generating Investment Problem						
	Alternative Generating Technologies					
Constraint or Objective	Hydro-power	Natural Gas Site A	Natural Gas Site B	Wind - Farm	Biofuel	Solar Panels
Capital Outlay (\$M)	\$400	\$170	\$150	\$100	\$50	\$120
Power Output (MW)	420	250	200	70	50	90
NPV (\$M) =>	\$180	\$100	\$80	\$50	\$7	\$20

Linear Programming (LP) formulation in LINGO format is shown below.

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!
! NG_A = 0 or 1 (NG_A = Natural Gas Site_A);
! NG_B = 0 or 1 (NG_B = Natural Gas Site_B);
! WFRM = 0 or 1 (WFRM = Wind Farm);
! BOFL = 0 or 1 (BOFL = Bio Fuel);
! SPNL = 0 or 1 (SNPL = Solar Panel);

MAX= 160 * HDPR + 100 * NG_A + 80 * NG_B + 50 * WFRM + 7 * BOFL + 20 * SPNL;

! subject to;
! Maximum investment is $700M;

400 * HDPR + 170 * NG_A + 150 * NG_B + 100 * WFRM + 50 * BOFL + 120 * SPNL <= 700;

! At least 100 MW From Renewable sources;

420 * HDPR + 70 * WFRM + 50 * BOFL + 90 * SPNL >= 100;

! At least 200 MW From Natural Gas;

250 * NG_A + 200 * NG_B >= 200;

! Every variable can attain a maximum value of ONE;

1 * HDPR <= 1;
1 * NG_A <= 1;
1 * NG_B <= 1;
1 * WFRM <= 1;
1 * BOFL <= 1;
1 * SPNL <= 1;

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Use branch and bound procedure (B & B ) and, apply linear programming relaxation to find a binary solution of the problem. Show all stages of your solution by solution tree. (USE LINGO to solve sub-problems)

**Question 2**

The Marriott Tub Company manufactures two lines of bathtubs, called model A and model B.

Every tub requires a certain amount of steel and zinc; the company has available a total of 25,000 pounds of steel and 6,000 pounds of zinc. Each model A bathtub requires a total of 125 pounds of steel and 20 pounds of zinc, and each yields a profit of \$90. Each model B bathtub can be sold for a profit of \$70; it in turn requires 100 pounds of steel and 30 pounds of zinc. Find the best production mix of the bathtubs by finding **all integer solution**, (Apply B & B method; apply linear programming relaxation; Use LINGO to find solution of a sub-problem at each node.

Show complete solution by enumeration tree)

**Question 3**

Androgynous Bicycle Company (ABC) has the hottest new products on the upscale toy market -- boys' and girls' bikes in bright fashion colors, with oversized hubs and axles, shell design safety tires, a strong padded frame, chrome-plated chains, brackets and valves, and a nonslip handlebar. Due to the seller's market for high-quality toys for the newest baby boomers, ABC can sell all the bicycles it manufactures at the following prices;

boys' bikes -- \$220,

girls' bikes -- \$175.

This is the price payable to ABC at its Orlando plant.

The firm's accountant has determined that direct labor costs will be 45% of the price ABC receives for the boys' model and 40% of the price received for the girls' model. Production costs other than labor, but excluding painting and packaging, are \$44 per boys' bicycle and \$30 per girls' bicycle. Painting and packaging are \$20 per bike, regardless of model. The Orlando plant's overall production capacity is 390 bicycles per day. Each boy's bike requires 2.5 labor hours and

each girl's model, 2.4 hours, to complete. ABC currently employs 120 workers, who each put in an 8- hour day. The firm has no desire to hire or fire to affect labor availability, for it believes its stable workforce is one of its biggest assets. Using a graphical approach, determine the best product mix for ABC by finding **all integer solution**, (Apply B & B method; apply linear programming relaxation; Use LINGO to find solution of a sub-problem at each node; Show complete solution by enumeration tree)