In[1]:=
```
(*************** Cash Flow Calculations During Construction *****************)
usdrsconversion = 55;
overnightcost = 4000; (* in dollars per megawatt *)
capacity = 1650 * 10^3; (*In Kilowatts *)
inflation = .05;
initialcostestimate = usdrsconversion * overnightcost * capacity;
startyear = 0;(*tells us, which year is the $0$ year *)
(*Find debt and equity for each year *)
cutoffyear = 6; (* This is put by hand. It is an estimate of when the company stops
 putting in its own equity. You may need to change this number, depending on the S-
  curve and the inflation rate if you demand that the final ratios should be 70:30*)
debtinterestrate = .1321; (*This corresponds to a nominal interest
 rate. To get the "real interest" rate subtract inflation. *)
eqrate = .1683;
(*This is again a nominal rate. The real
 rate is given by substracing the inflation rate *)
(*d = (1 + 0.7*0.7*debtinterestrate + 0.3*eqrate) ; *)
(*discount rate used to discount future payments and energy
 production. This is a weighted average of the debt interest rate and the
 return on equity. The debt interest rate is weighted by 0.7*0.7. The first
 0.7 comes from the fact that the debt is 0.7 of the total capital. The
 other 0.7 comes from the fact that the corporate tax rate is 30%,
and you don't have to pay tax on the debt interest payments. *)
eqratenpcil = 0.14; (*This is the rate used by the NPCIL.*)

(****************** Expenditure Curve using data from Kudankulam ************)
```

In[11]:=
```
expenditurecurve =
 {2454, 4168, 5476, 7634, 9571, 10592, 11947, 13002, 13811, 14811, 15824}
(* This data comes from the MOSPI reports on the
 progressive expenditure on Kudankulam *)
years = Length[expenditurecurve];
yearlyexpenditure =
  expenditurecurve - PadLeft[expenditurecurve[[1 ;; years - 1]], years];
escalation = Table[(1 + inflation)^(-n), {n, 0, years - 1}];
inflationadjustyearlyexpend = yearlyexpenditure * escalation;
dscurve = inflationadjustyearlyexpend / Total[inflationadjustyearlyexpend]
scurve = Table[Total[dscurve[[1 ;; n]]], {n, 1, years}]
(* S curve is the cumulative amount spent
 each year. ds curve is the amount spent each year. *)
```

Out[11]= {2454, 4168, 5476, 7634, 9571, 10592, 11947, 13002, 13811, 14811, 15824}

Out[16]= {0.18725, 0.124557, 0.0905268, 0.142243, 0.121596,
 0.0610418, 0.0771528, 0.0572105, 0.0417813, 0.0491863, 0.0474531}

Out[17]= {0.18725, 0.311808, 0.402335, 0.544578, 0.666174,
 0.727216, 0.804369, 0.861579, 0.903361, 0.952547, 1.}

In[18]:=
```
base = initialcostestimate * dscurve;
escalatedbase = base * Table[(1 + inflation)^n, {n, startyear, years + startyear - 1}];
intondebt = totalexpenditure = equity = debt = Table[0, {i, 1, years}];
```

In[21]:=
```
equity[[1]] = escalatedbase[[1]];
totalexpenditure[[1]] = escalatedbase[[1]];
For[i = 2, i < cutoffyear, i++,
 intsofar = Sum[debt[[j]], {j, 1, i - 1}] * debtinterestrate;
 debt[[i]] = (1 / 2) (escalatedbase[[i]] + intsofar) / (1 - debtinterestrate / 4);
 intondebt[[i]] = intsofar + (debtinterestrate / 2) * debt[[i]];
 totalexpenditure[[i]] =
  escalatedbase[[i]] + intsofar + (debtinterestrate / 2) * debt[[i]];
 equity[[i]] = debt[[i]]]
(***** Cutoff Year **********)
equity[[cutoffyear]] = x;
intsofar = Sum[debt[[j]], {j, 1, cutoffyear - 1}] * debtinterestrate;
debt[[cutoffyear]] = (escalatedbase[[cutoffyear]] + intsofar - equity[[cutoffyear]]) /
   (1 - debtinterestrate / 2);
intondebt[[cutoffyear]] = intsofar + (debtinterestrate / 2) * debt[[cutoffyear]];
totalexpenditure[[cutoffyear]] = equity[[cutoffyear]] + debt[[cutoffyear]];
(***** Beyond the Cutoff Year **********)
(**** Now there is no equity. There is no business of a penultimate year,
when one reactor starts functioning *********)

For[i = cutoffyear + 1, i ≤ years, i++,
 intsofar = Sum[debt[[j]], {j, 1, i - 1}] * debtinterestrate;
 debt[[i]] = (escalatedbase[[i]] + intsofar) / (1 - debtinterestrate / 2);
 intondebt[[i]] = intsofar + (debtinterestrate / 2) * debt[[i]]; totalexpenditure[[i]] =
  escalatedbase[[i]] + intsofar + (debtinterestrate / 2) * debt[[i]];
 equity[[i]] = 0]
```

In[30]:=
```
totaldebt = Total[debt];
totalexp = Total[totalexpenditure];
sol = Solve[totaldebt == 0.7 totalexp, x][[1]];
cashflowtable =
  {base, escalatedbase , debt , intondebt , equity, totalexpenditure} /. sol;
```

In[34]:=
```
TableForm[cashflowtable / 10^7]
```

Out[34]//TableForm=

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 6797.19 | 4521.43 | 3286.12 | 5163.43 | 4413.95 | 2215.82 | 2800.65 | 2076.74 | 1516.66 | 1785.46 | 1722. |
| 6797.19 | 4747.51 | 3622.95 | 5977.32 | 5365.18 | 2828.01 | 3753.13 | 2922.18 | 2240.8 | 2769.84 | 2805. |
| 0 | 2454.82 | 2041.02 | 3397.82 | 3313.39 | 2273.03 | 5925.21 | 5873.57 | 5974.77 | 7386.31 | 8469. |
| 0 | 162.141 | 459.092 | 818.327 | 1261.6 | 1630.59 | 2172.08 | 2951.39 | 3733.97 | 4616.47 | 5663. |
| 6797.19 | 2454.82 | 2041.02 | 3397.82 | 3313.39 | 2185.57 | 0 | 0 | 0 | 0 | 0 |
| 6797.19 | 4909.65 | 4082.04 | 6795.64 | 6626.78 | 4458.59 | 5925.21 | 5873.57 | 5974.77 | 7386.31 | 8469. |

In[35]:=
```
roundedcashflowtable = Round[cashflowtable / 10^7];
```

In[36]:=
```
TableForm[roundedcashflowtable]
```

Out[36]//TableForm=

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6797 | 4521 | 3286 | 5163 | 4414 | 2216 | 2801 | 2077 | 1517 | 1785 | 1723 |
| 6797 | 4748 | 3623 | 5977 | 5365 | 2828 | 3753 | 2922 | 2241 | 2770 | 2806 |
| 0 | 2455 | 2041 | 3398 | 3313 | 2273 | 5925 | 5874 | 5975 | 7386 | 8470 |
| 0 | 162 | 459 | 818 | 1262 | 1631 | 2172 | 2951 | 3734 | 4616 | 5664 |
| 6797 | 2455 | 2041 | 3398 | 3313 | 2186 | 0 | 0 | 0 | 0 | 0 |
| 6797 | 4910 | 4082 | 6796 | 6627 | 4459 | 5925 | 5874 | 5975 | 7386 | 8470 |

In[37]:=
```
totalcost = Total[totalexpenditure /. sol];
totalequity = Total[equity /. sol];
totaldebt = Total[debt /. sol];
```

In[40]:=
```
Print["Total Cost is ", totalcost / 10^7, " crores"]
Print["Ratio of Total cost to initial cost estimate is ",
 totalcost / initialcostestimate]
Print["Total Equity is ", totalequity / 10^7, " crores"]
Print["Total Debt is ", totaldebt / 10^7, " crores"]
```

```
Total Cost is 67299.4 crores

Ratio of Total cost to initial cost estimate is 1.85398

Total Equity is 20189.8 crores

Total Debt is 47109.6 crores
```

```
(****************************** Effective Rate on
 Equity ************************************************)
```

In[44]:=
```
effectiverate[naiverate_?NumericQ] :=
 Module[{r}, soleffectrate = FindRoot[naiverate * totalequity / Sum[
        (equity[[i]] (1 + r)^(years - i) /. sol), {i, 1, years}] == r, {r,  naiverate}];
  r /. soleffectrate]
(*This function solves for the effective rate of return on equity *)

(*The equity spent in initial years is sitting idle. So we
 can self consistently solve for the effective return on equity*)
Print["The effective rate on equity is ", effectiverate[eqrate]]
Print["The effective rate on equity with the NPCIL's assumptions is ",
 effectiverate[eqratenpcil]]
```

```
The effective rate on equity is 0.0861355

The effective rate on equity with the NPCIL's assumptions is 0.0768777
```

In[45]:=
```
FindRoot[effectiverate[t] == debtinterestrate,  {t, 0.25} ]
```

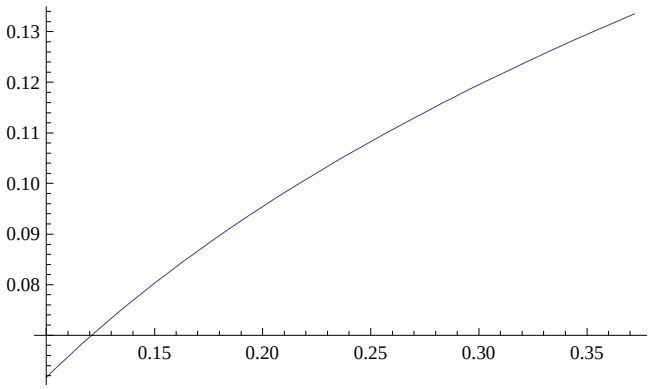
Out[45]= {t → 0.364112}

```
{{0.1, 1.0}, {0.06, 1.0}}
```

{{0.1, 1.}, {0.06, 1.}}

In[46]:=
```
effectiverateplot = Plot[effectiverate[x], {x, 0.1, 0.372}, PlotRange → Automatic]
```

Out[46]=



```
Export["c://users//suvrat//home//politics//epreconomics//effectiverateplot.png",
 effectiverateplot]
```

```
c://users//suvrat//home//politics//epreconomics//effectiverateplot.png
```

In[47]:=
```
xmin = 0.1;
xmax = 0.372;
maxc = 100;
effectiveratelist = Table[{xmin + c * (xmax - xmin) / maxc,
    effectiverate[xmin + c * (xmax - xmin) / maxc]}, {c, 1, maxc}];
(* For exporting into MS word! *)
```

In[51]:=
```
(****************************** The
 cost of fuel ************************************)
(**** Fuel Usage **********)
burnup = 50; (* in MWth-day/kg*)
electout = 1650; (* gross electrical output in MW *)
thermalout = 4500; (*thermal output in MW*)
efficiency = electout / thermalout;
loadfactor = 0.8;
```

In[56]:=
```
(*check Areva's figure for total lifetime
 energy production with a higher load factor *)
4500 * 60 * 365 * .93
```

Out[56]= $9.16515 \times 10^7$

In[57]:=
```
fuelkgperunit = 1000 / (24 * (burnup * efficiency))
(* kg per million units i.e. per 1000 MW-hr *)
kgperyear = (thermalout / burnup) * 365 * loadfactor
```

Out[57]= $\frac{25}{11}$

Out[58]= 26 280.

In[59]:=
```
(****** production cost for LEU *******
 Note that conservation of mass tells us that for a total feed,
F, tail T, and product P, we must have:
   F = T + P; x_f F = x_t T + x_p P;
and so F/P = (x_p - x_t)/(x_f - x_t)*)
xp = 5 * (1 / 100);
xt = 0.2 * (1 / 100);
xf = 0.7 * (1 / 100);
F = (xp - xt) / (xf - xt)
(*amount of raw uranium required to produce one unit of leu *)
V[x_] := (2 x - 1) Log[x / (1 - x)]
(* separative work per unit is  *)
Ns = V[xp] + (F - 1) V[xt] - F V[xf]
```

Out[62]= 9.6

Out[64]= 8.96434

In[65]:=
```
Cu = 150;
Cc = 10;
Cs = 160;
Cf = 250;
fuelrate = (F (Cu + Cc) + Ns Cs + Cf) * 1.1
```

Out[69]= 3542.32

In[70]:=
```
(******************** Calculation of Tariff **********************)


pmt[P_, r_, nyears_] := r (1 + r)^(nyears) P / ((1 + r)^(nyears) - 1)
(*Payment function defined for later usage. The idea here
 is as follows. You want to make a constant payment each year,
so that at the end of n years, you have recovered the initial amount
 and the compound interest it would have earned at the rate r. However,
when you make a payment in the first year, you can put that in the bank and earn
      compound interest at the same rate for (n-1) years ... the second year
    payment is earning for (n-2) years ... etc. This leads to the formula
  c (charge) = P (1 + r)^n/Sum[(1 + r)^j, {j, 0, n-1}].
    An alternate way to understand this is that when you make
  a payment for the first year, the amount you need to repay reduces,
and so now you need to pay interest only on that amount. *)
```

In[71]:=
```
(************* Calculation of Year by Year Tariff ******************)
lifetimeofreactor = 40;
yearlydetailedtariffs = Range[lifetimeofreactor];
tariffs = Range[lifetimeofreactor];
totalunitsperyear = capacity * 24 * 365 * loadfactor;
capacityfactor = .93;
omrate = .02;
depreciationrate = .0528;
depreciationyears = Round[0.9 / depreciationrate];
(*In this revenue model, depreciation happens at a constant nominal rate. So,
after 25 years, 90% of the value is gone,
and then we assume that depreciation stops.*)
netunits = totalunitsperyear * capacityfactor;
repaymentyears = 8;
(*This is the number of years over which you repay the full debt *)
(*Return on Equity *)
recoveryfactor = 1;
fuelrecoveryint = debtinterestrate;
(*This is the amount of the initial fuel cost that is
 recovered. Presumably you want all of it to be recovered, and not just 2/3,
which is what Thakur assumes. Thakur also assumes an interest rate of 11% for this,
but there is no reason for this to be different from the rate of interest on debt. *)
fuelrecoveryyears = 15;
initialfuelinventory = 127 * 10^3; (*The NPCIL figure is 84 * 10^3 *)
(*fuelkgperunit = 3.15;
Thakur's usage per million units. See above for the EPR usage *)
initialfuelcost = initialfuelinventory * fuelrate *
   usdrsconversion * (1 + inflation)^(years + startyear - 1);
intonworkingcap = .12;
earlyfuelinflationrate = .05;
latefuelinflationrate = .05;
variableinflationrate = .05;
(** Parameters for Calculating Working Capital ***)
wctc = .02; (*fraction of total cost *)
wcom = 1 / 12; (*fraction of O&M costs *)
wcfuel = 1 / 2; (*fraction of fuel cost*)
wctariff = 1 / 6; (*fraction of total tariff collection for the year *)
dccharge = .02;(* Set by hand *)
```

In[95]:=
```
debug = Range[lifetimeofreactor];
```

In[96]:=
```
calctariffs[multiplier_] := Module[{tariffs = Range[lifetimeofreactor],
   yearlydetailedtariffs = Range[lifetimeofreactor], totalcostmult,
   totalequitymult, totaldebtmult}, totalcostmult = totalcost * multiplier;
  totalequitymult = totalequity * multiplier; totaldebtmult = totaldebt * multiplier;
  (*This function calculates tariffs as a function of a
   "multiplier" which allows one to scale the overnight cost*)
  For[n = 0, n < lifetimeofreactor, n++,
   cost = {};
   variablescalation = (1 + variableinflationrate)^n;
   (****** Return on Equity *****)
   eq = totalequitymult;
   returnonequity = eq * eqrate / netunits;
   cost = Append[cost, {"returnonequity", returnonequity}];
```

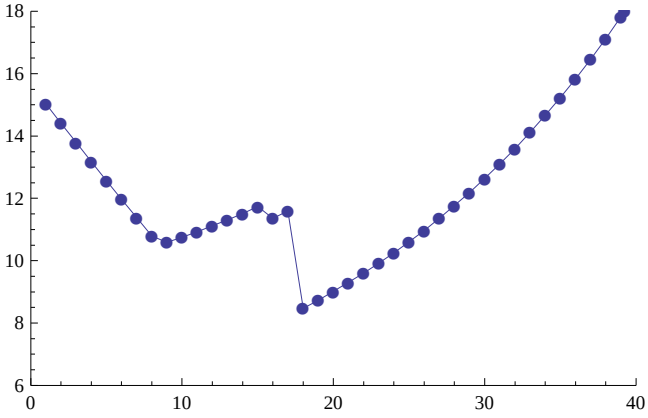
```
   (*Interest on Market Borrowings ********)
intmarketborr = totaldebtmult *
     ((2 repaymentyears - 1 - 2 n) / (2 repaymentyears)) * debtinterestrate / netunits;
   If[n ≥ repaymentyears, intmarketborr = 0];
   cost = Append[cost, {"intonmarketborrowings", intmarketborr}];
(***************** depreciation ****************)
   depreciation = (depreciationrate * totalcostmult) / netunits;
   If[n ≥ depreciationyears, depreciation = 0];
   cost = Append[cost, {"depreciation", depreciation}];
   (*** OM Costs **********)
   omcosts = variablescalation * omrate * totalcostmult;
   omcoststariff = omcosts / netunits;
   cost = Append[cost, {"omcosts tariff", omcoststariff}];
   (*fuel costs *)
totalinflation =
    (1 + earlyfuelinflationrate)^(years + startyear - 1) (1 + latefuelinflationrate)^n;
   fuelcost = (totalunitsperyear / 10^6) * fuelkgperunit *
     fuelrate * usdrsconversion * totalinflation;
   fueltariff = fuelcost / netunits;
   cost = Append[cost, {"fueltariff", fueltariff}];
   (****** fuel recovery costs ******)

   fuelrecoverycost = (pmt[(recoveryfactor) * initialfuelcost,
       fuelrecoveryint, fuelrecoveryyears] / netunits);
   If[n ≥ fuelrecoveryyears, fuelrecoverycost = 0];
   cost = Append[cost, {"fuelrecoverycost", fuelrecoverycost}];
   (** These costs stop after the end of the fuel recovery years ***)
   (*****************working capital ***************)
   (*The logic is that the working capital is 2% of completion cost +
    1 month of OM costs (which are also 2% of completion costs initially,
      but then escalate because of inflation) + 6 months of fuel + 2 months of energy
     receivables. The last figure depends on the tariff $t$. In the formula below,
   recall that omcosts and fuelcosts are already escalated. So we explicitly
    escalate only the part that depends on the "total cost"*)
workingcapital = variablescalation * wctc * totalcostmult +
     wcom * omcosts + wcfuel * fuelcost + t * netunits * wctariff;

   intworkingcapital = workingcapital * intonworkingcap / netunits;
cost = Append[cost, {"intworkingcapital", intworkingcapital}];
   (********** Decommissioning ***************)
   cost = Append[cost, {"decommissioning", dccharge}];

   tariffsol = Solve[t == Total[Transpose[cost][[2, All]]], t][[1]];
yearlydetailedtariffs[[n + 1]] = (cost /. tariffsol);
   debug[[n + 1]] = {variablescalation * wctc * totalcost ,
      wcom * omcosts, wcfuel * fuelcost, t * netunits * wctariff} /. tariffsol;
   tariffs[[n + 1]] = Total[Transpose[yearlydetailedtariffs[[n + 1]]][[2, All]]];
  {yearlydetailedtariffs, tariffs}]
```

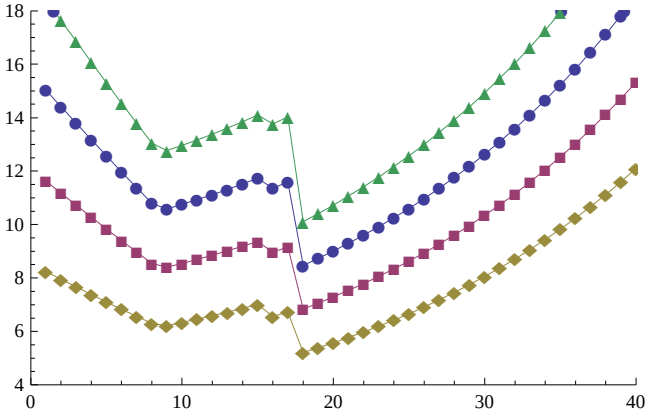
```
yearlydetailedtariffs2 = Range[lifetimeofreactor];
tariffs2 = Range[lifetimeofreactor];
yearlydetailedtariffs3 = Range[lifetimeofreactor];
tariffs3 = Range[lifetimeofreactor];
yearlydetailedtariffs4 = Range[lifetimeofreactor];
tariffs4 = Range[lifetimeofreactor];
yearlydetailedtariffs5 = Range[lifetimeofreactor];
tariffs5 = Range[lifetimeofreactor];
yearlydetailedtariffsanalytic = Range[lifetimeofreactor];
tariffsanalytic = Range[lifetimeofreactor];

{yearlydetailedtariffs, tariffs} = calctariffs[1.0];
{yearlydetailedtariffs2, tariffs2} = calctariffs[0.75];
{yearlydetailedtariffs3, tariffs3} = calctariffs[0.5];
{yearlydetailedtariffs4, tariffs4} = calctariffs[1.25];
{yearlydetailedtariffs5, tariffs5} = calctariffs[1.5];
{yearlydetailedtariffsanalytic, tariffsanalytic} = calctariffs[ξ];
```

```
tariffs
```

```
{15.0327, 14.4087, 13.7904, 13.178, 12.572, 11.9726, 11.3801, 10.7948, 10.5863, 10.7549,
 10.9319, 11.1178, 11.3129, 11.5179, 11.733, 11.3607, 11.5979, 8.47522, 8.73675, 9.01136,
 9.29969, 9.60244, 9.92033, 10.2541, 10.6046, 10.9726, 11.359, 11.7647, 12.1907, 12.638,
 13.1077, 13.6008, 14.1186, 14.6623, 15.2332, 15.8326, 16.462, 17.1229, 17.8168, 18.5454}
```

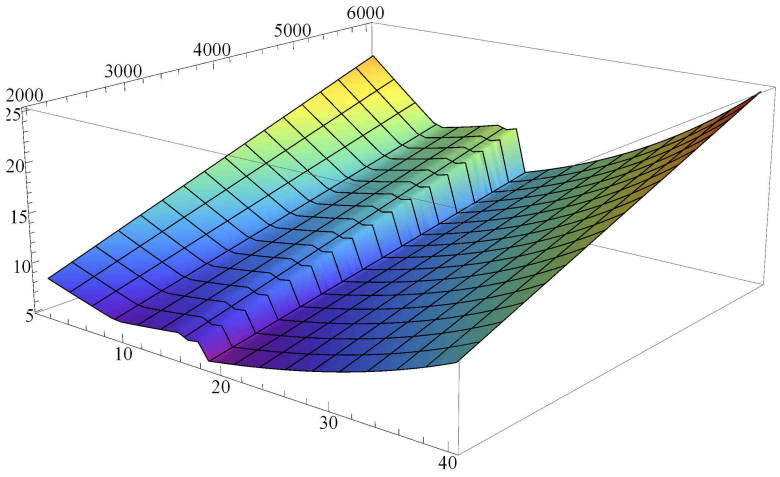
```
tariffplot = ListPlot[tariffs,
  PlotRange → {{0, 40}, {6, 18}}, Joined → True, PlotMarkers → Automatic]
tariffplotsampleovernight = ListPlot[{tariffs, tariffs2, tariffs3, tariffs4},
  PlotRange → {{0, 40}, {4, 18}}, Joined → True, PlotMarkers → Automatic]
```



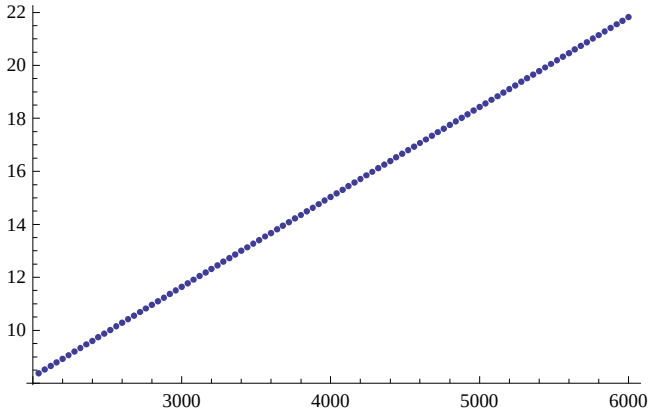




```
Clear[tariffslist];
Clear[data];
nopoints = 9;
data = Range[nopoints * lifetimeofreactor];
count = 1;
firstyeartariffs = Range[nopoints];
lowmult = 0.5;
highmult = 1.5;
For[m = 1, m ≤ nopoints, m++,
 multiplier = lowmult + (highmult - lowmult) * (m - 1) / (nopoints - 1);
 tariffslist[m] = calctariffs[multiplier][[2]];
 firstyeartariffs[[m]] = {multiplier * overnightcost, tariffslist[m][[1]]};
 For[m2 = 1, m2 ≤ Length[tariffslist[m]], m2++,
  data[[count++]] = {m2, multiplier * overnightcost,  tariffslist[m][[m2]]}]]
```

```
alldetailsplot = ListPlot3D[data, ColorFunction → "Rainbow"]
```




```
firstyearvsovernightplot = ListPlot[firstyeartariffs]
```



```
(********** The tariff varies linearly with the overnight
  cost of construction. The array tariffanalytic contains data about
  these coefficients. The formula is: t_n = f_n + v_n (O/4000) *)
tariffsanalytic = Simplify[tariffsanalytic]
fn = Range[lifetimeofreactor];
vn = Range[lifetimeofreactor];
fn = tariffsanalytic /. ζ → 0
vn = Chop[Simplify[(tariffsanalytic - fn) / ζ]]
```

```
{1.45749 + 13.5752 ζ, 1.49943 + 12.9093 ζ, 1.54347 + 12.2469 ζ, 1.58971 + 11.5883 ζ,
 1.63827 + 10.9337 ζ, 1.68925 + 10.2833 ζ, 1.74278 + 9.63728 ζ, 1.79899 + 8.99585 ζ,
 1.85801 + 8.72832 ζ, 1.91998 + 8.83493 ζ, 1.98504 + 8.94688 ζ, 2.05336 + 9.06442 ζ,
 2.1251 + 9.18784 ζ, 2.20042 + 9.31743 ζ, 2.27951 + 9.4535 ζ, 1.76433 + 9.59637 ζ,
 1.85153 + 9.74639 ζ, 1.94308 + 6.53214 ζ, 2.03922 + 6.69753 ζ, 2.14016 + 6.8712 ζ,
 2.24615 + 7.05355 ζ, 2.35743 + 7.24501 ζ, 2.47429 + 7.44605 ζ, 2.59698 + 7.65714 ζ,
 2.72581 + 7.87878 ζ, 2.86108 + 8.11151 ζ, 3.00311 + 8.35587 ζ, 3.15225 + 8.61245 ζ,
 3.30884 + 8.88186 ζ, 3.47326 + 9.16474 ζ, 3.6459 + 9.46177 ζ, 3.82718 + 9.77364 ζ,
 4.01752 + 10.1011 ζ, 4.21737 + 10.445 ζ, 4.42722 + 10.806 ζ, 4.64756 + 11.1851 ζ,
 4.87892 + 11.5831 ζ, 5.12184 + 12.0011 ζ, 5.37691 + 12.4399 ζ, 5.64474 + 12.9007 ζ}
```

```
{1.45749, 1.49943, 1.54347, 1.58971, 1.63827, 1.68925, 1.74278, 1.79899, 1.85801, 1.91998,
 1.98504, 2.05336, 2.1251, 2.20042, 2.27951, 1.76433, 1.85153, 1.94308, 2.03922, 2.14016,
 2.24615, 2.35743, 2.47429, 2.59698, 2.72581, 2.86108, 3.00311, 3.15225, 3.30884, 3.47326,
 3.6459, 3.82718, 4.01752, 4.21737, 4.42722, 4.64756, 4.87892, 5.12184, 5.37691, 5.64474}
```

```
{13.5752, 12.9093, 12.2469, 11.5883, 10.9337, 10.2833, 9.63728, 8.99585, 8.72832, 8.83493,
 8.94688, 9.06442, 9.18784, 9.31743, 9.4535, 9.59637, 9.74639, 6.53214, 6.69753, 6.8712,
 7.05355, 7.24501, 7.44605, 7.65714, 7.87878, 8.11151, 8.35587, 8.61245, 8.88186, 9.16474,
 9.46177, 9.77364, 10.1011, 10.445, 10.806, 11.1851, 11.5831, 12.0011, 12.4399, 12.9007}
```

```
Export["c://users//suvrat//home//politics//epreconomics//tariffplot.png", tariffplot]
Export[
 "c://users//suvrat//home//politics//epreconomics//tariffplotsampleovernight.png",
 tariffplotsampleovernight]
Export["c://users//suvrat//home//politics//epreconomics//firstyearvsovernight.png",
 firstyearvsovernightplot]
Export["c://users//suvrat//home//politics//epreconomics//alldetails.png",
 alldetailsplot]
```

```
c://users//suvrat//home//politics//epreconomics//tariffplot.png
```

```
c://users//suvrat//home//politics//epreconomics//tariffplotsampleovernight.png
```

```
c://users//suvrat//home//politics//epreconomics//firstyearvsovernight.png
```

```
c://users//suvrat//home//politics//epreconomics//alldetails.png
```

```
(************ First Year Tariff **********)
TableForm[yearlydetailedtariffs[[1]]]
```

```
returnonequity         3.15977
intonmarketborrowings  5.42528
depreciation           3.30433
omcosts tariff         1.25164
fueltariff             0.775548
fuelrecoverycost       0.586259
intworkingcapital      0.509901
decommissioning        0.02
```

```
(*********** Levelized Tariff Calculation ************)
d = 0.7 * 0.7 * debtinterestrate + 0.3 * eqrate;
(*discount rate used to discount future payments and energy production
 obtained as a weighted sum of capital. The debt is weighted with 0.7*
 0.7 because it is 70% of the total, and also because the corporate tax
 rate is 30% and you don't have to pay tax on the interest on debt. *)
Sum[tariffs[[n]] / (1 + d)^(n - 1), {n, 1, lifetimeofreactor}] /
 Sum[1 / (1 + d)^(n - 1), {n, 1, lifetimeofreactor}]
(** The significance of this calculation is a little unclear since
 it discounts electricity production and nominal tariff at the same
 discount rate. It may make more sense to discount electricity at a
 "real discount rate" and tariffs at a "nominal discount rate." **)
```

```
12.3168
```

```
(********************* Print Out Details of Each Years Tariff ***********)
For[n = 1, n ≤ lifetimeofreactor, n++,
 Print["********* Year ", n - 1, "**************"];
 Print[TableForm[yearlydetailedtariffs[[n]]]]; Print["====================="];
 Print["Total Tariff is ", tariffs[[n]]];
 Print["======================"]; Print["*** Working Capital is ",
  yearlydetailedtariffs[[n, 7, 2]] * netunits / intonworkingcap]]
```

```
********* Year 0**************

returnonequity         3.15977
intonmarketborrowings  5.42528
depreciation           3.30433
omcosts tariff         1.25164
fueltariff             0.775548
fuelrecoverycost       0.586259
intworkingcapital      0.509901
decommissioning        0.02

====================

Total Tariff is 15.0327

======================

*** Working Capital is 4.56947 × 10^10

********* Year 1**************
```

```
returnonequity         3.15977
intonmarketborrowings  4.70191
depreciation           3.30433
omcosts tariff         1.31422
fueltariff             0.814325
fuelrecoverycost       0.586259
intworkingcapital      0.507883
decommissioning        0.02
```

==========

Total Tariff is 14.4087

==========

*** Working Capital is $4.55138 \times 10^{10}$

********* Year 2**********

```
returnonequity         3.15977
intonmarketborrowings  3.97854
depreciation           3.30433
omcosts tariff         1.37993
fueltariff             0.855041
fuelrecoverycost       0.586259
intworkingcapital      0.506502
decommissioning        0.02
```

==========

Total Tariff is 13.7904

==========

*** Working Capital is $4.539 \times 10^{10}$

********* Year 3**********

```
returnonequity         3.15977
intonmarketborrowings  3.25517
depreciation           3.30433
omcosts tariff         1.44893
fueltariff             0.897793
fuelrecoverycost       0.586259
intworkingcapital      0.50579
decommissioning        0.02
```

==========

Total Tariff is 13.178

==========

*** Working Capital is $4.53262 \times 10^{10}$

********* Year 4**********

```
returnonequity         3.15977
intonmarketborrowings  2.5318
depreciation           3.30433
omcosts tariff         1.52138
fueltariff             0.942683
fuelrecoverycost       0.586259
intworkingcapital      0.50578
decommissioning        0.02
```

==========

Total Tariff is 12.572

==========

*** Working Capital is $4.53254 \times 10^{10}$

********* Year 5**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 1.80843 |
| depreciation | 3.30433 |
| omcosts tariff | 1.59745 |
| fueltariff | 0.989817 |
| fuelrecoverycost | 0.586259 |
| intworkingcapital | 0.506508 |
| decommissioning | 0.02 |

==========

Total Tariff is 11.9726

==========

*** Working Capital is $4.53906 \times 10^{10}$

********* Year 6**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 1.08506 |
| depreciation | 3.30433 |
| omcosts tariff | 1.67732 |
| fueltariff | 1.03931 |
| fuelrecoverycost | 0.586259 |
| intworkingcapital | 0.508011 |
| decommissioning | 0.02 |

==========

Total Tariff is 11.3801

==========

*** Working Capital is $4.55253 \times 10^{10}$

********* Year 7**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0.361685 |
| depreciation | 3.30433 |
| omcosts tariff | 1.76119 |
| fueltariff | 1.09127 |
| fuelrecoverycost | 0.586259 |
| intworkingcapital | 0.510327 |
| decommissioning | 0.02 |

==========

Total Tariff is 10.7948

==========

*** Working Capital is $4.57329 \times 10^{10}$

********* Year 8**********

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           3.30433
omcosts tariff         1.84924
fueltariff             1.14584
fuelrecoverycost       0.586259
intworkingcapital      0.520878
decommissioning        0.02
```

==========

Total Tariff is 10.5863

==========

*** Working Capital is $4.66784 \times 10^{10}$

********* Year 9**********

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           3.30433
omcosts tariff         1.94171
fueltariff             1.20313
fuelrecoverycost       0.586259
intworkingcapital      0.539708
decommissioning        0.02
```

==========

Total Tariff is 10.7549

==========

*** Working Capital is $4.83658 \times 10^{10}$

********* Year 10**********

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           3.30433
omcosts tariff         2.03879
fueltariff             1.26329
fuelrecoverycost       0.586259
intworkingcapital      0.559478
decommissioning        0.02
```

==========

Total Tariff is 10.9319

==========

*** Working Capital is $5.01376 \times 10^{10}$

********* Year 11**********

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           3.30433
omcosts tariff         2.14073
fueltariff             1.32645
fuelrecoverycost       0.586259
intworkingcapital      0.580238
decommissioning        0.02
```

==========

Total Tariff is 11.1178

==========

*** Working Capital is $5.19979 \times 10^{10}$

********* Year 12**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 3.30433 |
| omcosts tariff | 2.24777 |
| fueltariff | 1.39277 |
| fuelrecoverycost | 0.586259 |
| intworkingcapital | 0.602035 |
| decommissioning | 0.02 |

==========

Total Tariff is 11.3129

==========

*** Working Capital is $5.39512 \times 10^{10}$

********* Year 13**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 3.30433 |
| omcosts tariff | 2.36016 |
| fueltariff | 1.46241 |
| fuelrecoverycost | 0.586259 |
| intworkingcapital | 0.624922 |
| decommissioning | 0.02 |

==========

Total Tariff is 11.5179

==========

*** Working Capital is $5.60023 \times 10^{10}$

********* Year 14**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 3.30433 |
| omcosts tariff | 2.47816 |
| fueltariff | 1.53553 |
| fuelrecoverycost | 0.586259 |
| intworkingcapital | 0.648954 |
| decommissioning | 0.02 |

==========

Total Tariff is 11.733

==========

*** Working Capital is $5.81558 \times 10^{10}$

********* Year 15**********

returnonequity 3.15977
intonmarketborrowings 0
depreciation 3.30433
omcosts tariff 2.60207
fueltariff 1.61231
fuelrecoverycost 0
intworkingcapital 0.662222
decommissioning 0.02

==========

Total Tariff is 11.3607

==========

*** Working Capital is $5.93449 \times 10^{10}$

********* Year 16**********

returnonequity 3.15977
intonmarketborrowings 0
depreciation 3.30433
omcosts tariff 2.73218
fueltariff 1.69292
fuelrecoverycost 0
intworkingcapital 0.688717
decommissioning 0.02

==========

Total Tariff is 11.5979

==========

*** Working Capital is $6.17192 \times 10^{10}$

********* Year 17**********

returnonequity 3.15977
intonmarketborrowings 0
depreciation 0
omcosts tariff 2.86879
fueltariff 1.77757
fuelrecoverycost 0
intworkingcapital 0.649101
decommissioning 0.02

==========

Total Tariff is 8.47522

==========

*** Working Capital is $5.8169 \times 10^{10}$

********* Year 18**********

returnonequity 3.15977
intonmarketborrowings 0
depreciation 0
omcosts tariff 3.01222
fueltariff 1.86645
fuelrecoverycost 0
intworkingcapital 0.678311
decommissioning 0.02

==========

Total Tariff is 8.73675

==========

*** Working Capital is $6.07867 \times 10^{10}$

********* Year 19**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 0 |
| omcosts tariff | 3.16284 |
| fueltariff | 1.95977 |
| fuelrecoverycost | 0 |
| intworkingcapital | 0.708982 |
| decommissioning | 0.02 |

==========

Total Tariff is 9.01136

==========

*** Working Capital is $6.35353 \times 10^{10}$

********* Year 20**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 0 |
| omcosts tariff | 3.32098 |
| fueltariff | 2.05776 |
| fuelrecoverycost | 0 |
| intworkingcapital | 0.741186 |
| decommissioning | 0.02 |

==========

Total Tariff is 9.29969

==========

*** Working Capital is $6.64213 \times 10^{10}$

********* Year 21**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 0 |
| omcosts tariff | 3.48703 |
| fueltariff | 2.16065 |
| fuelrecoverycost | 0 |
| intworkingcapital | 0.775001 |
| decommissioning | 0.02 |

==========

Total Tariff is 9.60244

==========

*** Working Capital is $6.94516 \times 10^{10}$

********* Year 22**********

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         3.66138
fueltariff             2.26868
fuelrecoverycost       0
intworkingcapital      0.810507
decommissioning        0.02
```

```
====================
```

```
Total Tariff is 9.92033
```

```
======================
```

```
*** Working Capital is 7.26334 × 10^10
```

```
********* Year 23**************
```

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         3.84445
fueltariff             2.38211
fuelrecoverycost       0
intworkingcapital      0.847787
decommissioning        0.02
```

```
====================
```

```
Total Tariff is 10.2541
```

```
======================
```

```
*** Working Capital is 7.59743 × 10^10
```

```
********* Year 24**************
```

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         4.03667
fueltariff             2.50122
fuelrecoverycost       0
intworkingcapital      0.886932
decommissioning        0.02
```

```
====================
```

```
Total Tariff is 10.6046
```

```
======================
```

```
*** Working Capital is 7.94822 × 10^10
```

```
********* Year 25**************
```

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         4.2385
fueltariff             2.62628
fuelrecoverycost       0
intworkingcapital      0.928034
decommissioning        0.02
```

==========

Total Tariff is 10.9726

==========

*** Working Capital is $8.31656 \times 10^{10}$

********* Year 26**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 0 |
| omcosts tariff | 4.45043 |
| fueltariff | 2.75759 |
| fuelrecoverycost | 0 |
| intworkingcapital | 0.971191 |
| decommissioning | 0.02 |

==========

Total Tariff is 11.359

==========

*** Working Capital is $8.70331 \times 10^{10}$

********* Year 27**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 0 |
| omcosts tariff | 4.67295 |
| fueltariff | 2.89547 |
| fuelrecoverycost | 0 |
| intworkingcapital | 1.01651 |
| decommissioning | 0.02 |

==========

Total Tariff is 11.7647

==========

*** Working Capital is $9.1094 \times 10^{10}$

********* Year 28**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 0 |
| omcosts tariff | 4.9066 |
| fueltariff | 3.04025 |
| fuelrecoverycost | 0 |
| intworkingcapital | 1.06409 |
| decommissioning | 0.02 |

==========

Total Tariff is 12.1907

==========

*** Working Capital is $9.53579 \times 10^{10}$

********* Year 29**********

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         5.15193
fueltariff             3.19226
fuelrecoverycost       0
intworkingcapital      1.11405
decommissioning        0.02
```

```
====================
```

```
Total Tariff is 12.638
```

```
======================
```

```
*** Working Capital is 9.9835 × 10^10
```

```
********* Year 30**************
```

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         5.40952
fueltariff             3.35187
fuelrecoverycost       0
intworkingcapital      1.1665
decommissioning        0.02
```

```
====================
```

```
Total Tariff is 13.1077
```

```
======================
```

```
*** Working Capital is 1.04536 × 10^11
```

```
********* Year 31**************
```

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         5.68
fueltariff             3.51947
fuelrecoverycost       0
intworkingcapital      1.22158
decommissioning        0.02
```

```
====================
```

```
Total Tariff is 13.6008
```

```
======================
```

```
*** Working Capital is 1.09472 × 10^11
```

```
********* Year 32**************
```

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         5.964
fueltariff             3.69544
fuelrecoverycost       0
intworkingcapital      1.27942
decommissioning        0.02
```

==========

Total Tariff is 14.1186

==========

*** Working Capital is $1.14655 \times 10^{11}$

********* Year 33**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 0 |
| omcosts tariff | 6.2622 |
| fueltariff | 3.88021 |
| fuelrecoverycost | 0 |
| intworkingcapital | 1.34015 |
| decommissioning | 0.02 |

==========

Total Tariff is 14.6623

==========

*** Working Capital is $1.20097 \times 10^{11}$

********* Year 34**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 0 |
| omcosts tariff | 6.57531 |
| fueltariff | 4.07422 |
| fuelrecoverycost | 0 |
| intworkingcapital | 1.40391 |
| decommissioning | 0.02 |

==========

Total Tariff is 15.2332

==========

*** Working Capital is $1.25811 \times 10^{11}$

********* Year 35**********

| | |
|---|---|
| returnonequity | 3.15977 |
| intonmarketborrowings | 0 |
| depreciation | 0 |
| omcosts tariff | 6.90407 |
| fueltariff | 4.27793 |
| fuelrecoverycost | 0 |
| intworkingcapital | 1.47086 |
| decommissioning | 0.02 |

==========

Total Tariff is 15.8326

==========

*** Working Capital is $1.31811 \times 10^{11}$

********* Year 36**********

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         7.24928
fueltariff             4.49183
fuelrecoverycost       0
intworkingcapital      1.54116
decommissioning        0.02
```

```
====================
```

```
Total Tariff is 16.462
```

```
======================
```

```
*** Working Capital is 1.3811 × 10^11
```

```
********* Year 37**************
```

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         7.61174
fueltariff             4.71642
fuelrecoverycost       0
intworkingcapital      1.61497
decommissioning        0.02
```

```
====================
```

```
Total Tariff is 17.1229
```

```
======================
```

```
*** Working Capital is 1.44725 × 10^11
```

```
********* Year 38**************
```

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         7.99233
fueltariff             4.95224
fuelrecoverycost       0
intworkingcapital      1.69247
decommissioning        0.02
```

```
====================
```

```
Total Tariff is 17.8168
```

```
======================
```

```
*** Working Capital is 1.51671 × 10^11
```

```
********* Year 39**************
```

```
returnonequity         3.15977
intonmarketborrowings  0
depreciation           0
omcosts tariff         8.39195
fueltariff             5.19985
fuelrecoverycost       0
intworkingcapital      1.77385
decommissioning        0.02
```

```
====================
```

```
Total Tariff is 18.5454
```

```
======================
```

```
*** Working Capital is 1.58963 × 10^11
```

```
(******** Export this information to Excel ************)
For[n = 1, n ≤ lifetimeofreactor, n++,
  debug[[n]] = Join[yearlydetailedtariffs[[n, 1 ;; 8, 2]], {tariffs[[n]]}]];
Export["c://users//suvrat//home//politics//epreconomics//detailedtariff.xls",
 Transpose[debug], "XLS"]
```

```
c://users//suvrat//home//politics//epreconomics//detailedtariff.xls
```

```
For[n = 1, n ≤ lifetimeofreactor, n++, debug[[n]] =
   {n, tariffs[[n]], tariffs2[[n]], tariffs3[[n]], tariffs4[[n]], tariffs5[[n]]}];
Export["c://users//suvrat//home//politics//epreconomics//tariffcompare.xls",
 debug, "XLS"]
```

```
c://users//suvrat//home//politics//epreconomics//tariffcompare.xls
```

```
(*debug = Range[nopoints];
For[n = 1, n ≤ nopoints, n++,
 debug[[n]] = {(lowmult + (highmult - lowmult)*m/nopoints)*overnightcost,
   firstyeartariffs[[n]]};*)
(* PUT Correct formula here*)
Export["c://users//suvrat//home//politics//epreconomics//firstyeartariffs.xls",
 firstyeartariffs, "XLS"]
Export["c://users//suvrat//home//politics//epreconomics//tariffs3d.xls", data, "XLS"]
Export["c://users//suvrat//home//politics//epreconomics//tariffcoefficients.xls",
 Transpose[{vn, fn}], "XLS"]
```

```
c://users//suvrat//home//politics//epreconomics//firstyeartariffs.xls
```

```
c://users//suvrat//home//politics//epreconomics//tariffs3d.xls
```

```
Export::noopen : Cannot open c://users//suvrat//home//politics//epreconomics//tariffcoefficients.xls. ≫
```

```
$Failed
```

```
Transpose[{vn, fn}]
```

```
{{13.5752, 1.45749}, {12.9093, 1.49943}, {12.2469, 1.54347}, {11.5883, 1.58971},
 {10.9337, 1.63827}, {10.2833, 1.68925}, {9.63728, 1.74278}, {8.99585, 1.79899},
 {8.72832, 1.85801}, {8.83493, 1.91998}, {8.94688, 1.98504}, {9.06442, 2.05336},
 {9.18784, 2.1251}, {9.31743, 2.20042}, {9.4535, 2.27951}, {9.59637, 1.76433},
 {9.74639, 1.85153}, {6.53214, 1.94308}, {6.69753, 2.03922}, {6.8712, 2.14016},
 {7.05355, 2.24615}, {7.24501, 2.35743}, {7.44605, 2.47429}, {7.65714, 2.59698},
 {7.87878, 2.72581}, {8.11151, 2.86108}, {8.35587, 3.00311}, {8.61245, 3.15225},
 {8.88186, 3.30884}, {9.16474, 3.47326}, {9.46177, 3.6459}, {9.77364, 3.82718},
 {10.1011, 4.01752}, {10.445, 4.21737}, {10.806, 4.42722}, {11.1851, 4.64756},
 {11.5831, 4.87892}, {12.0011, 5.12184}, {12.4399, 5.37691}, {12.9007, 5.64474}}
```

```
debug[[1]]
```

```
{1, 15.0327, 11.6389, 8.24511, 18.4265}
```

```
firstyeartariffs[[1]]
```

```
{2040., 8.38086}
```