FinMath 36702 Assignment 4

Aman Krishna

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1. A loan can take one of four states as follows:

State	A	B	C	D
Probability of State	0.40	0.30	0.20	0.10
cPD	0.02	0.04	0.06	0.08
cLGD	0.10	0.30	0.50	0.70

Question 1. What is the value of:
- The expected loss of the loan (EL)?
- The expected LGD of the loan (ELGD)?
- The "time-weighted" LGD of the loan?

Solution

Calculating cLoss as $cLoss = cLGD * PD$

Our table results:

State	A	B	C	D
Probability of State	0.40	0.30	0.20	0.10
cPD	0.02	0.04	0.06	0.08
cLGD	0.10	0.30	0.50	0.70
cLoss	0.002	0.012	0.03	0.056

Calculating PD:

$$PD = 0.02 * 0.40 + 0.04 * 0.30 + 0.06 * 0.20 + 0.08 * 0.10$$
$$PD = 0.04$$

Calculating EL, ELGD, cLGD:

$$EL = 0.002 * .4 + 0.012 * 0.3 + 0.03 * 0.2 + 0.056 * 0.1 = 0.016$$

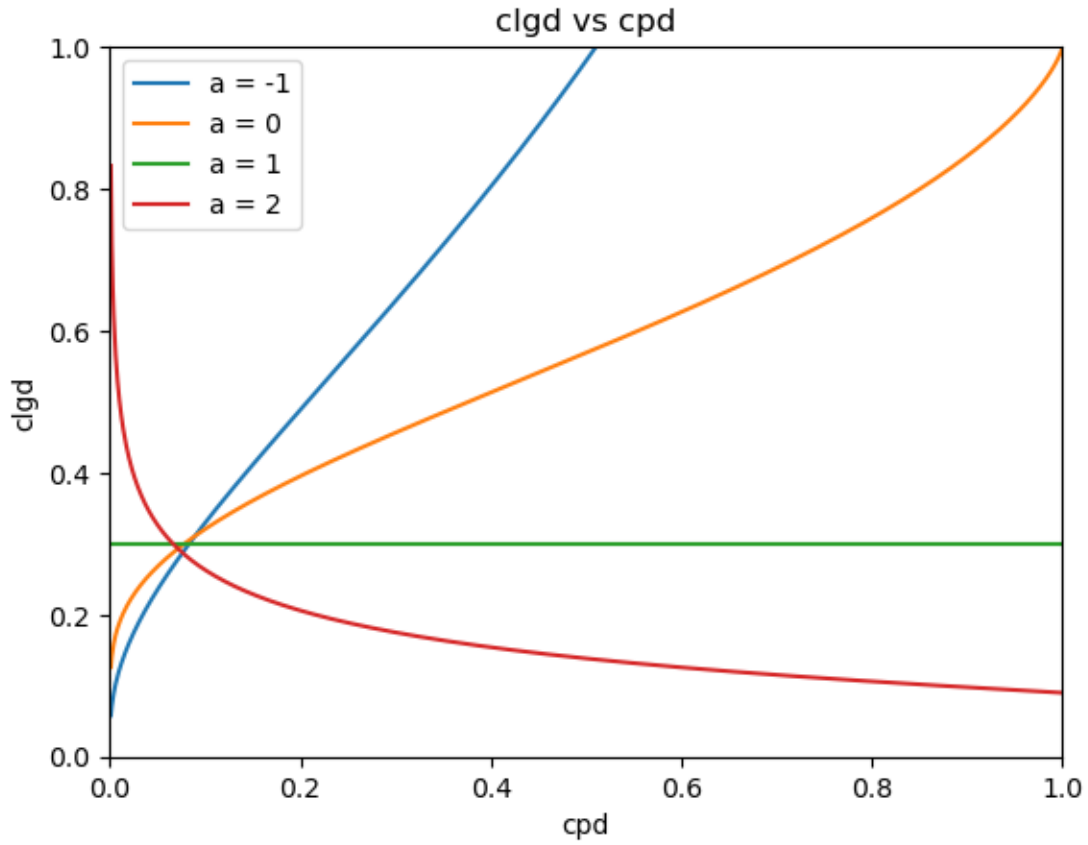
$$ELGD = \frac{EL}{PD} = \frac{0.016}{0.04} = 0.4$$

$$cLGD = 0.10 * 0.4 + 0.3 * 0.3 + 0.50 * 0.2 + 0.70 * 0.1 = 0.3$$

We observe that $E[cLGD] < ELGD$

2. Suppose that a loan is characterized by $PD = 5\%$, $ELGD = 30\%$, and $\rho = 15\%$. Suppose that instead of the LGD function preferred by Frye and Jacobs, this loan follows the "Variant A" alternative LGD function that the authors use for hypothesis testing. Plot the function within the unit square for four values of the "a" parameter: $-1, 0, 1, 2$.

Solution



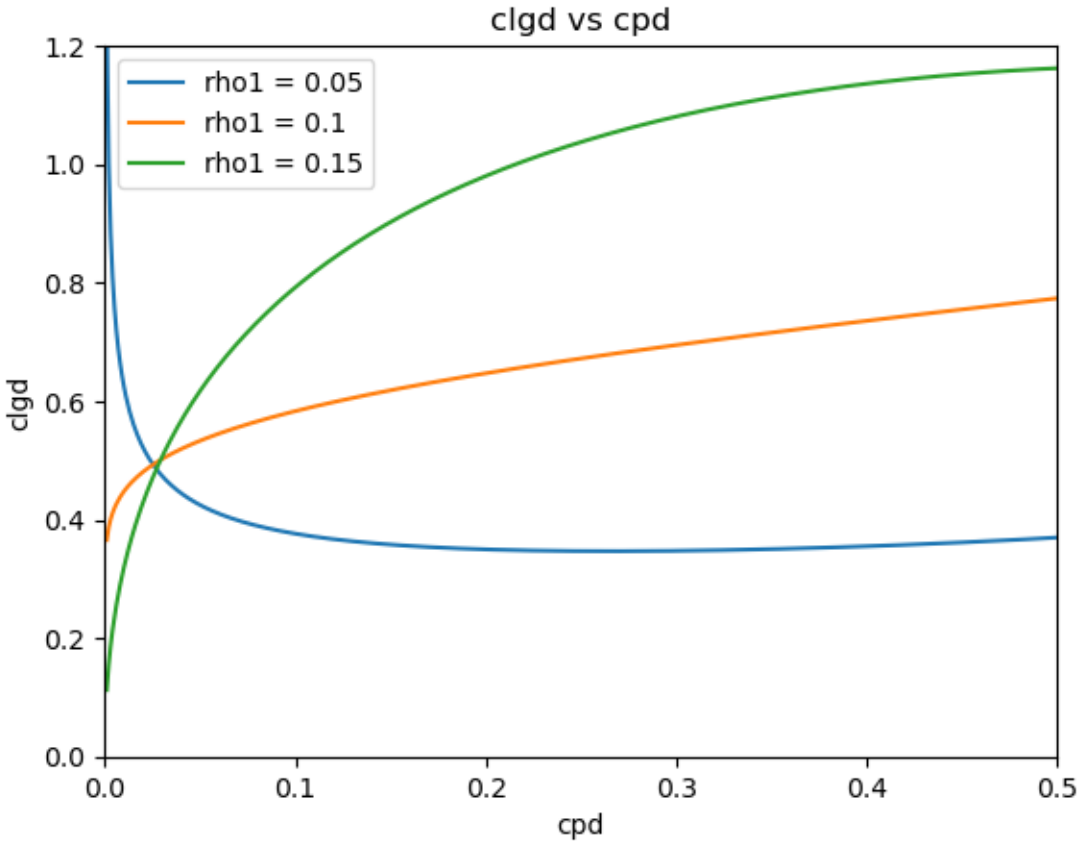
Please refer to the codebook for calculations

3. Suppose that $cPD \sim Vasicek[PD = 0.02, \rho = 0.10]$. Assuming that cPD and cLoss are comonotonic, plot three LGD functions for three possible distributions of cLoss:

(a) $cLoss \sim Vasicek[EL = 0.01, \rho = 0.05]$
(b) $cLoss \sim Vasicek[EL = 0.01, \rho = 0.1]$
(c) $cLoss \sim Vasicek[EL = 0.01, \rho = 0.15]$

Limit the default axis to $0, 0.5$ and limit the vertical axis to $0, 1.2$. Comment on the usefulness of each possible LGD function.

Solution



Please refer to the codebook for calculations

Usefulness of each of the three LGD functions:

1. The LGD function with rho=0.15 could be used in scenarios where we are seeing a very

high sensitivity of LGD to the PD. This would mean that for small changes in PD, the LGD would change/increase significantly. Firms like this would be more likely to be in the financial sector.

2. The LGD with rho=0.1 could be used in scenarios where we are seeing a moderate sensitivity of LGD to the PD. This would mean that for small changes in PD, the LGD would change/increase moderately. And as the LGD increases beying 0.1, the sensitivity of LGD to PD is almost flat. Firms like this would be more likely to be in the manufacturing sector.
3. The LGD with rho=0.05 could be used in scenarios where we see inverse relationship between LGD and PD upto cpd of 10%. This would mean that for small changes in PD, the LGD would actually decrease. I could not think of any sector where this would be the case.
4. In all the three functions we see the the clgd flatten oout with higher levels of cpd. The rho of 0.1 and 0.15 are more likely to be used in the real world as they are more realistic.

4. Using the assumptions of Question 3(b), what is the value of ELGD?

Solution

We use the basic definition of ELGD as mentioned in previous HW3

$EL/PD = 0.01/0.02 = 0.5$