ØAMET4100 · Spring 2019
Worksheet 4B

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1 Linear Probability Model (LPM)

Exercise 1.1 Suppose we are interested in investigating the determinants of women's labor force participation. Our dependent variable is $inlf$, which is a dummy variable equal to 1 if the woman is in the labor force (i.e., working for a wage outside the home at some point during the year) and 0 otherwise. The independent variables are $educ$ (years of education) and $kidslt6$ (number of children less than 6 years old).

Consider the results of the following LPM.

$$\widehat{inlf} = 0.052 + 0.046 \cdot educ - 0.224 \cdot kidslt6$$

(a) What is the predicted probability of labor force participation for a woman who has 12 years of education and 2 children under the age of 6 years old? 3 children under the age of 6 years old?

(b) Interpret the coefficient on $educ$.

(c) For a woman with 16 years of education, what is the predicted change in probability of labor force participation when going from 0 to 1 young child? From 1 young child to 2?

2 Probit

Exercise 2.1 Consider the same set up as in Exercise 1.1. Now, we estimate the regression using Probit, and we obtain the following results.

$$P(\widehat{inlf|educ}, kidslt6) = \Phi(-1.259 + 0.129 \cdot educ - 0.621 \cdot kidslt6)$$

(a) What is the predicted probability of labor force participation for a woman who has 12 years of education and 2 children under the age of 6 years old? 3 children under the age of 6 years old?

(b) Interpret the coefficient on *educ*.

(c) For a woman with 16 years of education, what is the predicted change in probability of labor force participation when going from 0 to 1 young child? From 2 young children to 3?

3 Logit

Exercise 3.1 Consider the same set up as in Exercise 1.1. Now, we estimate the regression using Logit, and we obtain the following results.

$$P(\widehat{inlf|educ}, kidslt6) = \Lambda(-2.053 + 0.210 \cdot educ - 1.010 \cdot kidslt6)$$

(a) What is the predicted probability of labor force participation for a woman who has 12 years of education and 2 children under the age of 6 years old? 3 children under the age of 6 years old?

(b) Interpret the coefficient on *educ*.

(c) For a woman with 16 years of education, what is the predicted change in probability of labor force participation when going from 0 to 1 young child? From 2 young children to 3?

4 Exercises

Exercise 4.1 (Stock & Watson, Review the Concepts 11.1) Suppose that a linear probability model yields a predicted value of Y that is equal to 1.3. Explain why this is non-sensical.

Exercise 4.2 (Stock & Watson, Review the Concepts 11.3) What is maximum likelihood estimation? What are the advantages of using maximum likelihood estimators such as probit and logit, instead of the linear probability model? How would you choose between the probit and the logit?

Exercise 4.3 Why are the coefficients of the probit and logit models estimated by maximum likelihood instead of OLS?

Exercise 4.4 You want to estimate how income affects the probability of voting for a right-wing candidate. The result from your logit model is the following:

$$\widehat{P(Right - wing} = 1|Income) = \Lambda(-1.00 + 0.02 Income)$$

where $Income$ is measured as monthly income in thousands of kroner.

(a) What is the probability of voting right-wing if the income is 100,000 kroner?

(b) What is the marginal effect of income, evaluated at the sample mean of income of 50,000 kroner?

Exercise 4.5 In order order to better target their marketing, a cell phone company wants to assess the determinants of cell phone subscribership. Their consultant estimates the following Linear Probability Model (LPM) using a sample of individuals older than 18 years of age:

$$CELL_i = \underset{(0.121)}{0.30} - \underset{(0.005)}{0.02}\, AGE_i + \underset{(0.020)}{0.05}\, EDUC_i + \underset{(0.006)}{0.10}\, ln(INCOME_i)$$

where $CELL$ is a dummy variable equal to 1 if person i subscribes to a cell service, 0 otherwise.

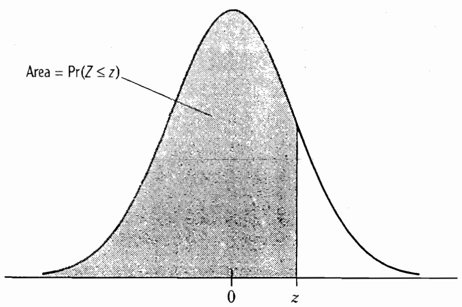
(a) What is the interpretation of the estimate of the coefficient on ln(INCOME)?

(b) Suppose you want to forecast the probability that a 50-year-old individual with 12 years of education, and income of $40,000 will own a cell phone. What prediction does this model make and does it make economic sense? [HINT: ln(40,000) = 10.6.]

(c) Instead of using a LPM, you recommend to the consultant to estimate a probit model using the dummy dependent variable CELL. Give the specification of the model and explain how to compute the estimates of the coefficients in the probit model.

Appendix

TABLE 1 The Cumulative Standard Normal Distribution Function, $\Phi(z) = \Pr(Z \le z)$



z	Second Decimal Value of z 0	1	2	3	4	5	6	7	8	9
−2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611

(Table 1 continued)

(Table 1 continued)

z	Second Decimal Value of z 0	1	2	3	4	5	6	7	8	9
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986

This table can be used to calculate $\Pr(Z \le z)$ where Z is a standard normal variable. For example, when $z = 1.17$, this probability is 0.8790, which is the table entry for the row labeled 1.1 and the column labeled 7.