2020

STATISTICS — HONOURS — PRACTICAL

Paper : DSE-A-1P

(Statistical Quality Control)

Full Marks : 30

The figures in the margin indicate full marks.

1. A manufacturer of outdoor sports-wear must control the water resistance and breathability of its jackets. Water resistance is measured by the amount of water (depth in millimeters) that can be suspended above the fabric before water seeps through. For its jackets, this test is done along the seams and zipper, where the resistance is likely the weakest. For one particular style of jacket, the manufacturing process has been stable with mean resistance 2750 mm and process standard deviation 430 mm.

   In each four-hour shift, an operator measures the resistance on a sample of four jackets. Table below gives the last 20 samples. The table also gives the mean for each sample.

Sample	Depth measurements	Sample mean
1	2345 2723 2345 2723	2534
2	3111 3058 2385 2862	2854
3	2471 2053 2526 3161	2553
4	2154 2968 2742 2568	2608
5	3279 2472 2833 2326	2728
6	3043 2363 2018 2385	2452
7	2689 2762 2756 2402	2652
8	2821 2477 2598 2728	2656
9	2608 2599 2479 3453	2785
10	3293 2318 3072 2734	2854
11	2664 2497 2315 2652	2532
12	1688 3309 3336 3183	2879
13	3499 3342 2923 3015	3195
14	2352 2831 2459 2631	2568
15	2573 2184 2962 2752	2618
16	2351 2527 3006 2976	2715
17	2863 2938 2362 2753	2729
18	3281 2726 3297 2601	2976
19	3164 2874 3730 2860	3157
20	2968 3505 2806 2598	2969

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Draw on plain paper suitable control charts for process monitoring, and comment. The table below gives the control chart constants : 15

Sample size n	c_4	c_5	B_5	B_6
2	0·7979	0·6028		2·606
3	0·8862	0·4633		2·276
4	0·9213	0·3889		2·088
5	0·9400	0·3412		1·964
6	0·9515	0·3076	0·029	1·874
7	0·9594	0·2820	0·113	1·806
8	0·9650	0·2622	0·179	1·751
9	0·9693	0·2459	0·232	1·707
10	0·9727	0·2321	0·276	1·669

2. Suppose a tyre supplier ships tyres in lots of size 400 to the buyer. The supplier and quality control inspector of the buyer decide the acceptance quality level (AQL) to be 2%. It is required to design a sampling plan (n, c) which ensures that lots of quality 2% will be rejected 5% of the time. From past experience, the acceptance number could be 1 or 2. Which one would you choose? Discuss aided by necessary computations. 15

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STATISTICS — HONOURS — PRACTICAL

Paper : DSE-A-1P

(Econometrics)

Full Marks : 30

Time : 2hrs 30 mins

The figures in the margin indicate full marks.

1. Consider the following data on output (O_t), capital input (K_t) and labour input (L_t) for the model,

$O_t = \alpha\, K_t^{\beta}\, L_t^{\delta}\, u_t$.

Year	log O	log K	log L
2001	2.84	4.08	1.36
2002	3.16	4.26	1.42
2003	3.29	4.53	1.51
2004	3.47	4.44	1.48
2005	3.59	4.71	1.57
2006	3.82	4.86	1.62
2007	4.03	5.07	1.69
2008	4.28	5.25	1.75

(a) Estimate the parameters of the model. Explain any problem that you may face.

(b) Does the additional information $\beta + \delta = 2$ help?

(c) If instead of (b), we have the following additional information, will it help?

Year	log O	log K	log L
2009	4.39	5.50	1.80
2010	4.48	5.72	1.88

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2. From the following data it is desired to find whether the price of oil influences the price of bituminous coal.

Year	Price of Oil (in cents)	Price of Bituminous Coal (in cents)
1962	70	24
1963	69	24
1964	68	24
1965	66	23
1966	64	23
1967	63	23
1968	61	22
1969	61	23
1970	59	27
1971	60	30
1972	58	31
1973	63	33
1974	102	57
1975	105	65
1976	106	63
1977	105	62
1978	103	64
1979	133	64
1980	204	59
1981	273	57

(a) Fit the model using ordinary least squares. Draw the residual plot on plain paper and comment on it.

(b) Perform the Durbin-Watson test to check for autocorrelation.

(c) Suppose it is known that the AR(1) error parameter $\rho = 0.8$. Find more efficient estimates of the regression parameters than obtained in (a).

(d) Estimate the standard errors of your estimators. 15

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