THE OPEN UNIVERSITY OF SRI LANKA
Department of Civil Engineering
Postgraduate Diploma in Technology - Construction Management - Level 7

CEX7107 – Construction Productivity & Quantitative Techniques

FINAL EXAMINATION – 2014/2015

Time Allowed: Three Hours

Date: 2015 - 09 - 01 (Tuesday) Time: 0930 - 1230 hrs

Answer Four (04) questions.

Section A - Construction Productivity

Q1.

i.) Preciesely define productivity and clearly describe similarities and differences between Productivity and Efficiency.

(08 marks)

ii.) Productivity at a construction site is influenced by numerous factors. According to your experience and opinion, enumerate and describe with reasoning, *five (05)* most significant factors that result in poor construction site productivity in Sri Lanka.

(08 marks)

iii.) Describe 'Work Study' accurately with reference to BS 3138 and explain its main two components and their significance in improvement of productivity in construction opertions.

(09 marks)

Q2.

i.) 'Forman Delay Survey' method has been suggested as an effective way in finding causes of dealys in construction operations. Describe the way of conduction this type of a survey and discuss *five (05)* significant delay causes that should be queried in a forman dealy survey form.

(08 marks)

ii.) Describe the procedure involved in Work Measurement (Time Study) with particular reference to "rating" as defined in BS 3138. Specifically discuss the factors affecting the **'rating'** for typical construction operations.

(08 marks)

iii.) Describe what is known as a 'Field Activity Count', inclusive of how it could be done at a construction site. Based on theories of statistics, a relationship could be developed relating the no. of observations for a given confidance limit reflecting a certain accuracy as depicted below. Describe the parameters in the relationship. $N = Z^2P(1-P)/L^2$

(09 marks)

Q3.

i.) A Construction Project Engineer attending as the Chairman at a project meeting has to keep several important issues clarified and a few strategic steps planned in advance so as to make the outcome of the meeting advantages to the project and improve the productivity. Identify and describe these issues and strategic steps.

(08 marks)

ii.) The process of negotiation is an important part of construction management. Define the term **"negotiation"** and explain its importance. Prepare a of list guidelines for the process to be effective.

(08 marks)

iii.) Discuss differences between **Remuneration** and **Incentives** and compare the advantages and disadvantages of following **three** financial incentive schemes applied to workers engaged in road construction work.

i.) Piecework schemes ii.) Hours saved schemes iii.) Geared schemes

(09 marks)

SECTION B – QUANTITATIVE TECHNIQUES

Q4. A concrete admixture manufacturer claims that their Super Plastiziser gives better workability & higher compressive strength in concrete as compared to normal high strength C55 concrete mixes. It is known that for a particular C55 concrete mix proportion, the 28 day mean compressive strength of cubes is 60 MPa with a standard deviation of 3 MPa. The same mix proportion with the particular admixture incorporated, gave following results for the 28 day compressive strength in MPa for 20 cubes tested.

63	60	64	70	69	64	65	68	70	55
55	67	58	59	60	56	69	62	56	44

Assuming the results are Normally distributed.

i.) (a) Estimate the mean & standard deviation for compressive strength with the admixure.

(b) What do you think about the manufacturers comment about strength? Discuss your answer. (07 marks)

ii.) Clearly state the null and the alternative hypotheses you would test to examine the validity of the manufacturer's claim about strength, stating whether these are one sided or two sided hypotheses. (05 marks)

iii.) Suggest a test statistic that can be used to test the validity of the hypothesis stated in part ii.). (05 marks)

iv.) Test the hypothesis stated in part ii.) using a 5% level of significance and clearly state your conclusions. (08 marks)

Q5. A Contractor buys precast/prestressed purlins from two manufacturers P and Q. Around 2% of the purlins supplied by P are defective and about 3% by Q are defective. A lot of 1000 purlins consist of about 60% supplied by P. From this lot of 1000 purlins, a batch of 20 is randomly selected for inspection.

i.) Compute the probability of finding defective purlin from the lot of 1000. (05 marks)

ii.) If an inspected purlin is found to be defective, what is the probability that it was supplied by manufacturer P. (05 marks)

iii.) What is the probability that all 20 purlins inspected are in good condition? (05 marks)

iv.) What is the probability of finding at least one defective purlin from the batch of 20? (05 marks)

iv.) Suppose the markup by the Contractor is Rs. 120/- from each of the purlins in good condition and the loss from each of the defective purlins is Rs. 50/-. Estimate the net profit for the Contractor from the lot of 1000 purlins. (05 marks)

Q6. The summary statistics obtained from a set of data on compressive strength x and intrinsic permeability y of various concrete mixes are;

$$n = 14, \sum y_i = 572, \sum y_i^2 = 23{,}530, \sum x_i = 43,$$

$$\sum x_i^2 = 157.42 \text{ and } \sum x_i y_i = 1697.80.$$

Assume that a simple linear regression model is adequate to describe the relationship between the two variables.

i.) Find the equation of the regression line from the method of least squares. (06 marks)

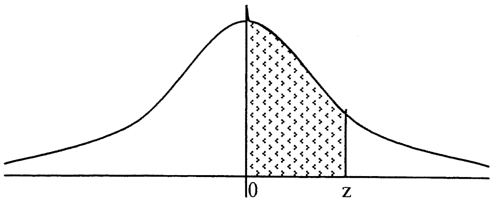
ii.) Use the equation of the fitted line to predict the permeability of a concrete mix with a compressive strength of 4.3. (06 marks)

iii.) Give a point estimate of the mean permeability when the compressive strength is 3.7. (06 marks)

iv.) Supposing that the observed permeability of a sample from the data set with a compressive strength of 3.7 is 46.1, calculate the value of the corresponding residual and describe what is represented by it. (07 marks)

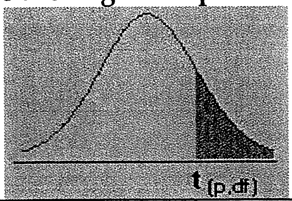
Standard Normal Distribution

Areas under the Standard Normal Curve form 0 to z for various values of z



z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0	0.004	0.008	0.012	0.016	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0754
0.2	0.0793	0.0832	0.0871	0.091	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.148	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.17	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.219	0.2224
0.6	0.2258	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2518	0.2549
0.7	0.2580	0.2612	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2996	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.437	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.475	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.483	0.4834	0.4838	0.4842	0.4846	0.485	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.496	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.497	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.498	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.49995	0.49995	0.49996	0.49996	0.49996	0.49996	0.49996	0.49996	0.49997	0.49997
4.0	0.49997									
4.5	0.49999									
5.0	0.49999									

t table with right tail probabilities



df\p	0.40	0.25	0.10	0.05	0.025	0.01	0.005	0.0005
1	0.324920	1.000000	3.077684	6.313752	12.70620	31.82052	63.65674	636.6192
2	0.288675	0.816497	1.885618	2.919986	4.30265	6.96456	9.92484	31.5991
3	0.276671	0.764892	1.637744	2.353363	3.18245	4.54070	5.84091	12.9240
4	0.270722	0.740697	1.533206	2.131847	2.77645	3.74695	4.60409	8.6103
5	0.267181	0.726687	1.475884	2.015048	2.57058	3.36493	4.03214	6.8688
6	0.264835	0.717558	1.439756	1.943180	2.44691	3.14267	3.70743	5.9588
7	0.263167	0.711142	1.414924	1.894579	2.36462	2.99795	3.49948	5.4079
8	0.261921	0.706387	1.396815	1.859548	2.30600	2.89646	3.35539	5.0413
9	0.260955	0.702722	1.383029	1.833113	2.26216	2.82144	3.24984	4.7809
10	0.260185	0.699812	1.372184	1.812461	2.22814	2.76377	3.16927	4.5869
11	0.259556	0.697445	1.363430	1.795885	2.20099	2.71808	3.10581	4.4370
12	0.259033	0.695483	1.356217	1.782288	2.17881	2.68100	3.05454	4.3178
13	0.258591	0.693829	1.350171	1.770933	2.16037	2.65031	3.01228	4.2208
14	0.258213	0.692417	1.345030	1.761310	2.14479	2.62449	2.97684	4.1405
15	0.257885	0.691197	1.340606	1.753050	2.13145	2.60248	2.94671	4.0728
16	0.257599	0.690132	1.336757	1.745884	2.11991	2.58349	2.92078	4.0150
17	0.257347	0.689195	1.333379	1.739607	2.10982	2.56693	2.89823	3.9651
18	0.257123	0.688364	1.330391	1.734064	2.10092	2.55238	2.87844	3.9216
19	0.256923	0.687621	1.327728	1.729133	2.09302	2.53948	2.86093	3.8834
20	0.256743	0.686954	1.325341	1.724718	2.08596	2.52798	2.84534	3.8495
21	0.256580	0.686352	1.323188	1.720743	2.07961	2.51765	2.83136	3.8193
22	0.256432	0.685805	1.321237	1.717144	2.07387	2.50832	2.81876	3.7921
23	0.256297	0.685306	1.319460	1.713872	2.06866	2.49987	2.80734	3.7676
24	0.256173	0.684850	1.317836	1.710882	2.06390	2.49216	2.79694	3.7454
25	0.256060	0.684430	1.316345	1.708141	2.05954	2.48511	2.78744	3.7251
26	0.255955	0.684043	1.314972	1.705618	2.05553	2.47863	2.77871	3.7066
27	0.255858	0.683685	1.313703	1.703288	2.05183	2.47266	2.77068	3.6896
28	0.255768	0.683353	1.312527	1.701131	2.04841	2.46714	2.76326	3.6739
29	0.255684	0.683044	1.311434	1.699127	2.04523	2.46202	2.75639	3.6594
30	0.255605	0.682756	1.310415	1.697261	2.04227	2.45726	2.75000	3.6460