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 - 2007

Time Allowed: Three Hours

Date: 2008 - 05 - 04 (Sunday) Time: 0930 - 1230 hrs

Answer Four (04) questions. Statistical Tables will be Provided.

SECTION A - CONSTRUCTION PRODUCTIVITY

Q1.

i.) Clearly identify *five (05)* significant factors that could affect the Productivity of a construction site and describe them.

(08 marks)

ii.) 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)

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

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

(09 marks)

Q2.

i.) 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)

ii.) Describe in detail the basic stages involved in carrying out a method study and discuss the utility of Multiple Activity Charts in the process.

(08 marks)

iii.) Discuss the advantages of using the method known as 'Activity Sampling' in productivity evaluation of construction work in the light of convenience, economy, speed and validity.

(09 marks)

Q3.

i.) 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)

ii.) Productivity of people involved in any endeavour, is greatly influenced by **physiological** as well as **psychological** aspects related to human beings. Describe and discuss the bearing of following factors, on construction productivity;

a.) Stress condition/level of the person concerned
b.) Energy cycle of the individual

(08 marks)

iii.) "**Time Robbers**" are identified as the situations, which retard the productivity of a person or, a group of people engaged in a particular activity. List *ten (10)* of the most significant time robbers that hinder the productivity of Construction project managers as applicable to the Sri Lankan context.

(09 marks)

SECTION B – QUANTITATIVE TECHNIQUES

Q4. The resistance measured (in ohms) on 60 resistors randomly selected from a production are given below.

41	37	41	42	43	39	38	41	41	40
42	45	45	45	48	47	49	43	51	42
47	48	44	42	43	41	44	38	46	40
42	41	39	40	44	44	37	46	42	41
35	41	46	31	45	48	41	44	45	42
43	42	43	47	48	41	40	38	37	44

i.) Construct a cumulative frequency table taking each class width to be equal to 2.5 and first class mid point to be 30.0.

(08 marks)

ii.) Construct a suitable graphical summary to summarise the information presented in the table developed in 'i.)'.

(09 marks)

iii.) Use the graphical summary constructed in 'ii.)' to estimate

a.) the probability that the resistance of a randomly chosen resistor will exceed 40 ohms.

(04 marks)

b.) the number of resistors that will have a resistance in the range from 35ohms to 40 ohms, if 1000 resistors randomly chosen from the production are inspected.

(04 marks)

Q5. An industrial Engineer believes that there is a relationship between the number of defective items produced by a machine and the speed at which the machine operates. The following are summary statistics computed from the data collected by a student on 30 randomly chosen runs where x denote the speed of the machine (rps) and y denote the number of defectives per hour.

$$\sum x_i = 395\,,\ \sum y_i = 182\,,\ \sum x_i^2 = 5555\,,\ \sum y_i^2 = 1250\,,\ \sum x_i y_i = 2592$$

i.) Estimate the Pearson correlation coefficient between the number of defectives produced per hour and the machine speed and interpret it.

(05 marks)

ii.) Find the equation of the regression line that can be used to predict the number of defective items produced by the machine in an hour when operated at a given speed using least squares.

(08 marks)

iii.) Use the regression line obtained in 'ii.)' to predict the number of defectives produced by the machine when operated at 15 rps.

(04 marks)

iv.) Accidentally, the student has deleted the observed number of defectives per hour when the machine was operated at 15rps. However, the regression output obtained prior to deletion of this observation indicates that the residual of this observation is 1.1. What is the value of the deleted observation?

(04 marks)

v.) During a night shift, the machine has produced around 9 defectives per hour. Give an estimate of the speed at which the machine was operated.

(04 marks)

Q6. The diameter of steel rods produced by a machine is roughly normally distributed. The sample mean and sample standard deviation of the diameters of 22 rods randomly selected from the output of the machine was found to be 8.20 mm and 1.1 mm. The manufacturer claims that the mean diameter of the rods produced by this machine will exceed 8.25mm.

i.) Write down the hypothesis you would test to examine the validity of the manufacturer's claim.

(05 marks)

ii.) Test the validity of the manufacturer's claim using a 5% significance level. Clearly state your findings.

(08 marks)

iii.) Now suppose the mean diameter of the rods produced by the machine is 8.50 mm with a standard deviation of 1.2 mm. Suppose all rods with diameter less than 8 mm or more than 8.50 mm are regarded as defectives

a.) Estimate the probability that a randomly chosen rod will be defective.

(06 marks)

b.) If a sample of 1000 rods is examined, estimate the number of defective rods that can be found.

(06 marks)

Q7. A company involved in producing paint has two machines for mixing the paint. Machines fail independently. The probability that any one of these machines fail is 1%. These machines are operated only by a specially trained operator. The probabilities that the operator will be on leave when both machines are out of order is 10%. The probability that the operator will be on leave when only one machine is out of order is 5%. The probability that the operator will be on leave when none of the machines are out of order is 1%.

i.) Compute the probability that both machines are out of order on a randomly chosen day.

(06 marks)

ii.) Compute the probability that only one of the machines is out of order on a randomly chosen day.

(06 marks)

iii.) Compute the probability that the operator will be on leave on a randomly chosen day.

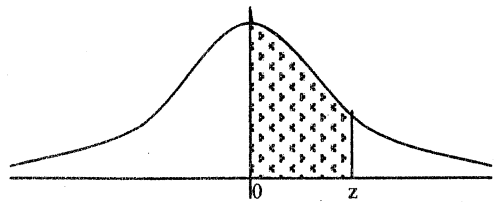
(06 marks)

iv.) On a given day, the operator was found to be on leave. What is the probability that both machines were in working condition on that day.

(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									