國立成功大學 109 學年度碩士班招生考試試題

系　　所：製造資訊與系統研究所

考試科目：生產管理　　考試日期：0210，節次：2

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

***Questions* [45%]**

Please answer the following questions briefly and justify your answer.

1. **[*18%*]** System and Theory of Constraint (TOC): (a) What is the definition of the system and its related components? (b) What is the production system and its related component? (c) What's TOC? How to define and identify bottleneck? (d) What is Drum-Buffer-Rope (DBR)? Give an example to describe how the DBR works. (e) Explain briefly the advantages and disadvantages of using buffers. (f) When increasing the size of buffer, what's the expected result and how does it affect the key performance indices (KPIs)?

2. **[*12%*]** Productivity and Benchmarking: (a) What is the definition of productivity? (b) How to drive productivity? List three approaches. (c) What is benchmarking and what is the steps for benchmarking? (d) How to drive the bottleneck machine by benchmarking approach?

3. **[*15%*]** Manufacturing Executive System (MES) and Scheduling: (a) What is manufacturing executive system (MES)? Why do we need MES? (b) What is the production activities control (PAC)? (c) What is the relationship between MES and PAC? (d) How does the MES support the rolling scheduling? (e) Please give three KPIs and their definitions for evaluating the performance of the production scheduling.

***Numerical Problem and Analysis* [55%]**

Please answer the following numerical questions and show all your work in detail.

4. **[*18%*]** Production Machine and Little's Law

NCKU company produces New Year gifts, which require machining on a driller machine. The operation route is a streamline through two operations (A and B). Assume the NCKU company will be operating 5 days per week, 16 hours per day. The driller machine requires tool changes and preventive maintenance after every 500 gifts production and each tool change takes 30 minutes. The information of operations is shown as follows.

Operation	Standard processing time	Efficiency	Reliability	Scrap (defect rate)
A	3 min	90%	95%	2%
B	6 min	95%	80%	5%

(a) **[*2%*]** Please draw the manufacturing route.

(b) **[*10%*]** How many number of machines required for operation A and B, respectively, for producing 3000 gifts per week?

(c) **[2%]** Based on the answer from (b), which operation is the bottleneck?

(d) **[4%]** Based on the answer from (b) and Little's Law, what is the production cycle time when keeping the WIP (work-in-process) level equal to 100?

5. **[13%]** Job Assignment Problem

In NCKU, one professor would like to assign the research projects to his/her lab graduate students; that is, n students should be assigned to n projects. Let $i = \{1,2,\ldots,n\}$ represent an index of student and $j = \{1,2,\ldots,n\}$ be an index of projects. C_{ij} is the cost of assigning student i to handle project j. Let x_{ij} be the "binary" decision variable, where $x_{ij} = 1$ if student i is assigned to project j; otherwise $x_{ij} = 0$. Now, there are 5 students should be assigned to 5 projects. The cost matrix is shown as following table. The cost presents the hour-spent to finish the project, and the "M" represents a very large positive number which indicates that the student cannot support the project due to the lack of the corresponding skill.

		Research Project				
	C_{ij}	1	2	3	4	5
	1	14	11	23	30	19
	2	15	14	17	22	M
Student	3	4	1	M	12	7
	4	19	10	20	24	12
	5	31	25	35	37	29

(a) **[5%]** Give a linear programming formulation for assignment problem by introducing the appropriate notations and decision variables.

(b) **[5%]** Find the optimal solution of assignment by Hungarian method and show the optimal solutions with minimal total cost.

(c) **[3%]** What's the basic idea or principle to use the Hungarian method?

6. **[16%]** Quality Assurance and Control Chart

NCKU semiconductor manufacturing company produces 8-inch wafers. The quality inspection process involves selecting wafers at random and counting the number of defects on each wafer. The last 20 wafers (i.e. samples) with sample size n=250 examined revealed the following numbers of defects:

Wafer	Number of Defects	Wafer	Number of Defects
1	3	11	4
2	3	12	6
3	5	13	4
4	5	14	6
5	9	15	8
6	1	16	4
7	4	17	7
8	2	18	5
9	6	19	5
10	4	20	2

(a) **[*3%*]** What is an estimate of the centerline proportion defective?

(b) **[*6%*]** Compute the upper control limit (UCL) and lower control limit (LCL) with the 2-sigma (standard deviation) for p-chart.

(c) **[*4%*]** What are the Type-I error and Type-II error in quality control? Describe and explain it.

(d) **[*3%*]** What's the expected result on Type-I error and Type-II error when increasing standard deviation from 2-sigma to 3-sigma?

7. **[*8%*]** Inventory Management

NCKU fast-food restaurant sells hamburger. The weekly demand for hamburger is normally distributed with a mean of 3,000 and a standard deviation of 600. The replenishment lead-time is two weeks. Assume that the demand is independent from one week to the next. Evaluate the service level from a policy of ordering 9,000 hamburgers when there are 5,000 hamburgers in inventory (See appendix for reference).

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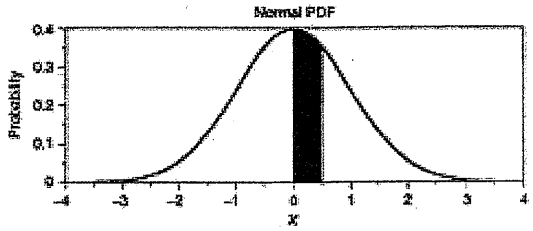
Appendix- Standard Normal Distribution Table



Area under the Normal Curve from 0 to X

X	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.00000	0.00399	0.00798	0.01197	0.01595	0.01994	0.02392	0.02790	0.03188	0.03586
0.1	0.03983	0.04380	0.04776	0.05172	0.05567	0.05962	0.06356	0.06749	0.07142	0.07535
0.2	0.07926	0.08317	0.08706	0.09095	0.09483	0.09871	0.10257	0.10642	0.11026	0.11409
0.3	0.11791	0.12172	0.12552	0.12930	0.13307	0.13683	0.14058	0.14431	0.14803	0.15173
0.4	0.15542	0.15910	0.16276	0.16640	0.17003	0.17364	0.17724	0.18082	0.18439	0.18793
0.5	0.19146	0.19497	0.19847	0.20194	0.20540	0.20884	0.21226	0.21566	0.21904	0.22240
0.6	0.22575	0.22907	0.23237	0.23565	0.23891	0.24215	0.24537	0.24857	0.25175	0.25490
0.7	0.25804	0.26115	0.26424	0.26730	0.27035	0.27337	0.27637	0.27935	0.28230	0.28524
0.8	0.28814	0.29103	0.29389	0.29673	0.29955	0.30234	0.30511	0.30785	0.31057	0.31327
0.9	0.31594	0.31859	0.32121	0.32381	0.32639	0.32894	0.33147	0.33398	0.33646	0.33891
1.0	0.34134	0.34375	0.34614	0.34849	0.35083	0.35314	0.35543	0.35769	0.35993	0.36214
1.1	0.36433	0.36650	0.36864	0.37076	0.37286	0.37493	0.37698	0.37900	0.38100	0.38298
1.2	0.38493	0.38686	0.38877	0.39065	0.39251	0.39435	0.39617	0.39796	0.39973	0.40147
1.3	0.40320	0.40490	0.40658	0.40824	0.40988	0.41149	0.41308	0.41466	0.41621	0.41774
1.4	0.41924	0.42073	0.42220	0.42364	0.42507	0.42647	0.42785	0.42922	0.43056	0.43189
1.5	0.43319	0.43448	0.43574	0.43699	0.43822	0.43943	0.44062	0.44179	0.44295	0.44408
1.6	0.44520	0.44630	0.44738	0.44845	0.44950	0.45053	0.45154	0.45254	0.45352	0.45449
1.7	0.45543	0.45637	0.45728	0.45818	0.45907	0.45994	0.46080	0.46164	0.46246	0.46327
1.8	0.46407	0.46485	0.46562	0.46638	0.46712	0.46784	0.46856	0.46926	0.46995	0.47062
1.9	0.47128	0.47193	0.47257	0.47320	0.47381	0.47441	0.47500	0.47558	0.47615	0.47670
2.0	0.47725	0.47778	0.47831	0.47882	0.47932	0.47982	0.48030	0.48077	0.48124	0.48169
2.1	0.48214	0.48257	0.48300	0.48341	0.48382	0.48422	0.48461	0.48500	0.48537	0.48574
2.2	0.48610	0.48645	0.48679	0.48713	0.48745	0.48778	0.48809	0.48840	0.48870	0.48899
2.3	0.48928	0.48956	0.48983	0.49010	0.49036	0.49061	0.49086	0.49111	0.49134	0.49158
2.4	0.49180	0.49202	0.49224	0.49245	0.49266	0.49286	0.49305	0.49324	0.49343	0.49361
2.5	0.49379	0.49396	0.49413	0.49430	0.49446	0.49461	0.49477	0.49492	0.49506	0.49520
2.6	0.49534	0.49547	0.49560	0.49573	0.49585	0.49598	0.49609	0.49621	0.49632	0.49643
2.7	0.49653	0.49664	0.49674	0.49683	0.49693	0.49702	0.49711	0.49720	0.49728	0.49736
2.8	0.49744	0.49752	0.49760	0.49767	0.49774	0.49781	0.49788	0.49795	0.49801	0.49807
2.9	0.49813	0.49819	0.49825	0.49831	0.49836	0.49841	0.49846	0.49851	0.49856	0.49861
3.0	0.49865	0.49869	0.49874	0.49878	0.49882	0.49886	0.49889	0.49893	0.49896	0.49900
3.1	0.49903	0.49906	0.49910	0.49913	0.49916	0.49918	0.49921	0.49924	0.49926	0.49929
3.2	0.49931	0.49934	0.49936	0.49938	0.49940	0.49942	0.49944	0.49946	0.49948	0.49950
3.3	0.49952	0.49953	0.49955	0.49957	0.49958	0.49960	0.49961	0.49962	0.49964	0.49965
3.4	0.49966	0.49968	0.49969	0.49970	0.49971	0.49972	0.49973	0.49974	0.49975	0.49976
3.5	0.49977	0.49978	0.49978	0.49979	0.49980	0.49981	0.49981	0.49982	0.49983	0.49983
3.6	0.49984	0.49985	0.49985	0.49986	0.49986	0.49987	0.49987	0.49988	0.49988	0.49989
3.7	0.49989	0.49990	0.49990	0.49990	0.49991	0.49991	0.49992	0.49992	0.49992	0.49992
3.8	0.49993	0.49993	0.49993	0.49994	0.49994	0.49994	0.49994	0.49995	0.49995	0.49995
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	0.49997	0.49997	0.49997	0.49997	0.49997	0.49998	0.49998	0.49998	0.49998