

National Exams May 2011

07-Mec-B4, Integrated Manufacturing Systems

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is an OPEN BOOK EXAM.
Any non-communicating calculator is permitted.
3. Any five questions constitute a complete paper. Only the first five (5) questions as they appear in your answer book will be marked.
4. Each question is of equal value.
5. Some questions require an answer in essay format. Clarity and organization of the answer are important.

1.
 - a) Should materials handling labour cost be a direct cost or an indirect one? Give reasons.
 - b) List the reasons for considering plant layout at the same time materials handling requirements are determined.
 - c) To what extent does low material handling cost depend upon efficient materials handling systems?

2.
 - a) A lightweight component in an electrical assembly has a reliability of 0.70. Provision of two redundant units can be tolerated with no appreciable effect on weight specifications. If two redundant units of the same component are installed, what will be the compound reliability of the three?
 - b) An assembly, through specification, can be reduced from six components to three components. The reliability of each of the six components is 0.98. Presuming no change in component reliabilities, what would be the change in the assembly reliability with reduction of components?

3. a) The annual amount ordered from one raw material supplier is \$260,000. Order costs are 1% of the value of each order, and carrying costs are 18% of the average inventory level. How many weeks of supply should be ordered at one time?

b) Parts used in assembly work are purchased from a supplier who has a remarkable record for prompt delivery. The inventory history closely follows an instantaneous replenishment pattern. However, to be on the safe side, a policy is followed of never planning an inventory level below 500 parts. The following costs are applicable:

procurement cost	=	\$60 per order
carrying cost	=	\$0.20 per unit per year based on average inventory

If the demand is 40,000 parts per year used at a steady rate, what is the total annual inventory cost?

4. The resistance measured in ohms of a particular type of electrical component is obtained from 30 subgroups of size $n=3$. These data are listed below. Compute trial control limits for an \bar{X} and R chart.

<i>Subgroup Number</i>	X_1	X_2	X_3
1	207	194	201
2	204	191	203
3	198	201	196
4	195	199	181
5	199	221	218
6	200	200	207
7	222	195	205
8	215	186	181
9	188	199	191
10	171	200	201
11	200	201	192
12	204	207	194
13	191	215	200
14	201	204	200
15	198	212	206
16	231	188	223
17	202	210	219
18	187	190	205
19	194	196	207
20	196	199	190
21	198	208	200
22	185	206	201
23	209	225	226
24	199	199	208
25	214	203	195
26	208	202	199
27	202	205	185
28	195	210	199
29	206	191	200
30	205	198	202

Factors for Computing Control Chart Line

Table of the Factors for Computing Control Chart Lines

Number of Observations in	Chart for Averages			Chart for Standard Deviations								Chart for Ranges				
	Factors for Control Limits			Factors for Central Line		Factors for Control Limits				Factors for Central Line		Factors for Control Limits				
Sample, n	A	A ₁	A ₂	c ₂	1/c ₂	B ₁	B ₂	B ₃	B ₄	d ₂	1/d ₂	d ₃	D ₁	D ₂	D ₃	D ₄
2	2.121	3.760	1.880	0.5642	1.7725	0	1.843	0	3.267	1.128	0.8865	0.853	0	3.686	0	3.267
3	1.732	2.394	1.023	0.7236	1.3820	0	1.858	0	2.568	1.693	0.5907	0.838	0	4.353	0	2.575
4	1.500	1.880	0.729	0.7979	1.2533	0	1.808	0	2.266	2.059	0.4857	0.880	0	4.698	0	2.282
5	1.342	1.596	0.577	0.8407	1.1894	0	1.756	0	2.059	2.328	0.4299	0.864	0	4.918	0	2.115
6	1.225	1.410	0.483	0.5686	1.1512	0.026	1.711	0.030	1.970	2.534	0.3945	0.848	0	5.078	0	2.004
7	1.134	1.277	0.419	0.8882	1.1259	0.105	1.672	0.118	1.882	2.704	0.3698	0.833	0.205	5.203	0.076	1.924
8	1.061	1.175	0.373	0.9027	1.1078	0.167	1.638	0.185	1.815	2.847	0.3512	0.829	0.387	5.307	0.136	1.864
9	1.000	1.094	0.337	0.9139	1.0942	0.219	1.609	0.239	1.761	2.970	0.3367	0.803	0.546	5.394	0.164	1.816
10	0.949	1.028	0.308	0.9227	1.0837	0.262	1.584	0.284	1.716	3.078	0.3249	0.797	0.687	5.469	0.223	1.777
11	0.905	0.973	0.285	0.9300	1.0753	0.299	1.561	0.321	1.679	3.173	0.3152	0.787	0.812	5.534	0.258	1.744
12	0.865	0.925	0.266	0.9359	1.0684	0.331	1.541	0.354	1.646	3.258	0.3069	0.778	0.924	5.592	0.284	1.716
13	0.832	0.884	0.249	0.9410	1.0627	0.359	1.523	0.382	1.618	3.336	0.2993	0.770	1.026	5.646	0.308	1.692
14	0.802	0.848	0.235	0.9153	1.0579	0.384	1.507	0.405	1.594	3.407	0.2935	0.762	1.121	5.693	0.329	1.671
15	0.775	0.816	0.223	0.9400	1.0537	0.406	1.492	0.428	1.572	3.472	0.2880	0.755	1.207	5.737	0.348	1.652
16	0.750	0.788	0.212	0.9523	1.0501	0.427	1.478	0.448	1.552	3.532	0.2831	0.749	1.285	5.779	0.364	1.635
17	0.728	0.762	0.203	0.9551	1.0170	0.445	1.465	0.466	1.534	3.588	0.2787	0.743	1.359	5.817	0.379	1.621
18	0.707	0.735	0.194	0.9576	1.0442	0.461	1.454	0.482	1.518	3.640	0.2747	0.739	1.426	5.854	0.392	1.608
19	0.688	0.717	0.187	0.9599	1.0413	0.477	1.443	0.497	1.503	3.689	0.2711	0.733	1.490	5.888	0.404	1.596
20	0.671	0.697	0.180	0.9619	1.0396	0.491	1.433	0.510	1.490	3.735	0.2677	0.723	1.548	5.922	0.414	1.586
21	0.655	0.679	0.173	0.9638	1.0376	0.504	1.424	0.523	1.477	3.778	0.2647	0.724	1.606	5.950	0.425	1.576
22	0.640	0.662	0.167	0.9655	1.0358	0.516	1.415	0.534	1.406	3.819	0.2618	0.720	1.659	5.979	0.434	1.566
23	0.626	0.647	0.162	0.9670	1.0342	0.527	1.407	0.545	1.455	3.858	0.2582	0.716	1.710	6.006	0.443	1.557
24	0.612	0.632	0.157	0.9684	1.0327	0.638	1.399	0.555	1.445	3.895	0.2567	0.712	1.759	6.031	0.452	1.548
25	0.600	0.619	0.153	0.9696	1.0313	0.548	1.392	0.565	1.436	3.931	0.2544	0.709	1.804	6.058	0.459	1.541
	3	3					†		†							
Over 25		\sqrt{n}	\sqrt{n}													

$$*1 - \frac{3}{\sqrt{2n}} \quad \dagger 1 + \frac{3}{\sqrt{2n}}$$

5.
 - a) Define a generative process planning system.
 - b) What are the objectives of a machinability data system?
 - c) What are the benefits of computer-aided process planning?

6. The transportation and processing costs for the three final candidate locations for a manufacturing plant are roughly equal. The critical qualitative factors have received the following weights and evaluation scores on a 5-point scale (5 = excellent) from the site selection committee. Select the best site on the basis of the weighted scores.

Factor	Weight	Location		
		A	B	C
Labor supply	0.20	5	4	4
Labor relations	0.30	3	4	5
Supporting services	0.25	5	3	3
Waste disposal	0.15	4	4	4
Community Attitude	0.10	5	4	3

7. The historical demand for a product is: January, 80; February, 100; March, 60; April, 80; and May, 90.
- a. Using a simple four-month moving average, what is the forecast for June? If June experienced a demand of 100, what would your forecast be for July?
 - b. Using single exponential smoothing with $\alpha = 0.20$, if the forecast for January had been 70, compute what the exponentially smoothed forecast would have been for the remaining months through June.
 - c. Using least squares regression analysis, compute a forecast for June, July, and August.
 - d. Using a weighted moving average with weights of 0.30, 0.25, 0.20, 0.15, and 0.10, what is June's forecast?