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UGBA 141 SPRING 2022

Practice Midterm Exam

Name: _____ SID: _____

Instructions

SHOW ALL OF YOUR WORK on this exam. No credit is given on the quantitative questions unless work is shown. There is no penalty for guessing on multiple choice questions. Each question is worth 1 point and no partial credit is given. Points are not subtracted for incorrect answers, so it is in your interest to answer all questions.

PLEASE WRITE YOUR ANSWERS WITH A PEN (NOT A PENCIL).

YOU MUST PUT YOUR FINAL ANSWERS INSIDE THE ANSWER BOXES.

Do not round your answers unless requested to do so (e.g., the answer must be an integer). Do not round your intermediate calculations.

During the exam, you may not consult with anyone, and we will not answer any questions.

You may use one double-sided reference sheet of paper during this exam that does not exceed 8.5" x 11". You cannot share reference sheets with others.

You may use a calculator on this exam as long as the calculator cannot communicate with another device. Calculators cannot be shared with others. You may not use computers, tablets, cell phones, or any electronic device. All phones must be turned off.

To make your calculations as straightforward as possible, assume that, **unless stated otherwise**:

- there are sufficient parts or raw materials so that the initial operation(s) are never starved;
- processing times have negligible variability, and over time, workers neither speed up nor slow down, but work always at the processing rates given;
- there are no machine breakdowns;
- when there are buffers shown, they are large enough to accommodate any amount of inventory that would reside in those buffers under normal operations;
- travel time and time to transport parts from one operation to the next is negligible;
- all operations run with 100% yield, i.e., the operations produce no defective units; and
- all processes are in steady state (e.g., in the middle of the day); thus, you may ignore any start-up effects.
- there are 52 weeks and 365 days per year.

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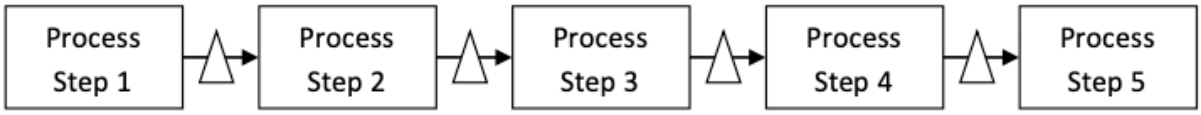
A. Bose

The following diagram depicts a five-step Bose headphone manufacturing plant.



Step 1 involves a worker bending a metal strip into an arc shape. In step 2, the metal arc is fitted with a plastic sleeve. In step 3, the headphones are fitted at the end of the metal and plastic strips. In step 4, the wires are soldered into the headphones. Step 5 involves a specially designed packaging unit. The plant manager notes the following:

	# workers or machines	Processing information per worker or machine
Step 1	3	70 seconds per headphone
Step 2	1	3 headphones per minute
Step 3	2	2 headphones per minute
Step 4	2	45 seconds per headphone
Step 5	1	20 seconds per headphone

Q1. What is the capacity (headphones per hour) of step 5?

Q2. How many headphones per hour can the manufacturing plant produce?

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B. Café Strada Goes Minimal

Adopting a minimalist approach, Café Strada decides to only offer a single product: espresso. The espresso operation is very simple and only takes three employees: A cashier to take orders and two baristas to operate the two espresso machines. Having taken UGBA141, the owners have carefully timed this two-step process:

- Step 1, taking orders and operating the cash register, takes 35 seconds per customer.
- Step 2, it takes each barista 1 minute and 20 seconds to complete each customer's drink order.

Q3. If demand is 85 customers per hour, then what is the utilization (%) of the baristas?

Q4. If demand is 125 customers per hour, what is the utilization (%) of the cashier?

Q5. If each employee costs $15 per hour, and say they are popular enough to be supply constrained, what is the direct cost of labor ($) for each cup of espresso?

Q6. Café Strada is concerned with how many customers they can serve per hour. They will hire one employee and this employee can be assigned to either the cashier or to making drinks. They will purchase additional equipment so that the employee can do the assigned task. Assume the processing times do not change.

What is Café Strada's capacity (customers per hour) after hiring this employee?

Café Strada uses 50 bags of whole bean coffee every month, and you may assume that demand is perfectly steady throughout the year. Café Strada has signed a year-long contract to purchase its coffee from a local supplier, Berkeley Beans, for a price of $25 per bag and an $85 fixed cost for every delivery independent of the order size. The holding cost due to storage is $1 per bag per month. Café Strada managers figure their cost of capital is approximately 2 percent per month.

Q7. What is the optimal order size, in bags, and how many times a year does Café Strada place orders?

Q8. Given your answer in Q=7, how many months of supply of coffee does PBK have on average, and how many dollars per month does Café Strada spend to hold coffee (including cost of capital)?

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Q9. Suppose that a South American import/export company has offered Café Strada a deal for the next year. Café Strada can buy a year's worth of coffee directly from South America for $20 per bag and a fixed cost for delivery of $500. Assume the estimated cost for inspection and storage is $1 per bag per month and the cost of capital is approximately 2 percent per month.

Should Café Strada order from Berkeley Beans or the South American import/export company? Quantitatively justify your answer.

Q10. For each of the components of the Triple Bottom Line framework, describe one strategy that can help Café Strada operates more sustainably. Use information provided in the previous questions and/or your own observations/assumptions.

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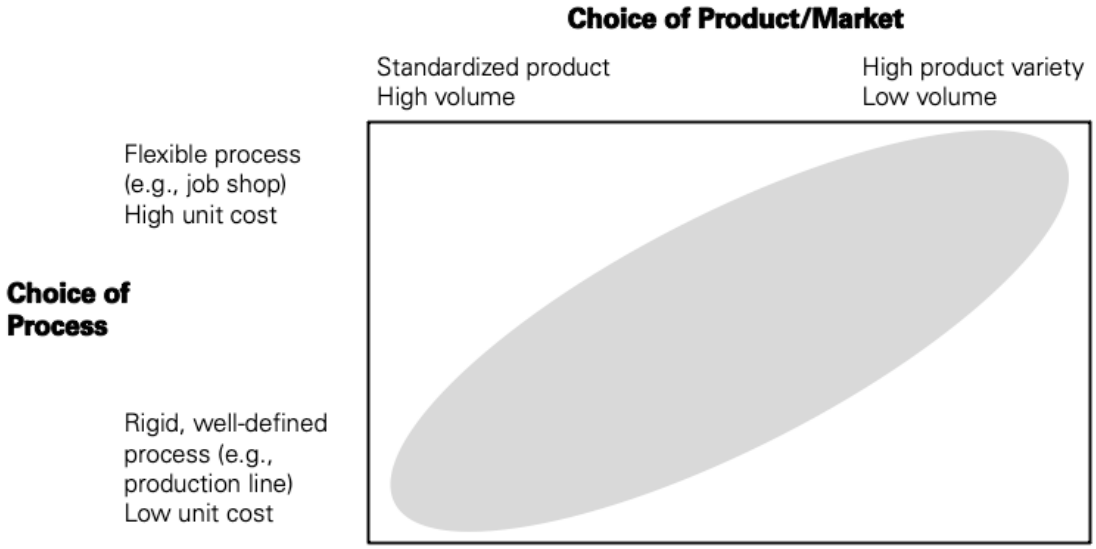
D. UC Berkeley's Recreational Sports Facility (RSF)

Q11. Place these four companies in the Product-Process Matrix

- Tesla Assembly Plant (Fremont, CA)
- Ocean Spray Cranberry Processing Facility (Kenosha, WI)
- Sukiyabashi Jiro (from *Jiro's Dream of Sushi*) (Tokyo, Japan)
- Personal Training at UC Berkeley's RSF (Berkeley, CA)



Q12. Based on in-class discussions on Kristen's Cookie Company and Ritz-Carlton, describe <u>three process improvements</u> that a personal training service at RSF should employ?

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E. AT&T Call Center

The help desk at AT&T handles calls from customers regarding their WiFi routers. The help desk is divided into two groups. The first group is called the "Frontline" and it is staffed with 5 people. The second group is called the "Solver" and it is staffed with 3 people.

There are three types of calls: "Routine", "Stumper", and "Nasty". All three types are first received by the Frontline desk. A Frontline staffer can resolve a Routine call in 10 minutes. The Frontline staffer also spends 10 minutes with the Stumper and Nasty calls but is unable to resolve those calls in that time. Hence, after 10 minutes, the Frontline staffer forwards the Stumper and Nasty calls to the Solver desk.

At the Solver desk a staffer takes 15 minutes to resolve a Stumper call and 30 minutes to resolve a Nasty call. The table below includes the processing times, staffing and arrival rates for each of the three types of calls:

	Processing time (min) at the…		
Types of issues	Frontline desk	Solver desk	Calls per hour
Routine	10	n.a.	20
Stumper	10	15	5
Nasty	10	30	2

Desk	Staffing
Frontline	5
Solver	3

Q13. What is the implied utilization of the Frontline desk?

Q14. What is the implied utilization of the Solver desk?

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F. Herbal Medication

A pharmacy is preparing a special medication for a rare disease. The medication should have 10 grams of leaves of a special herb as its main active ingredient. However, given natural variation in the leave sizes and the leave harvesting the actual weight varies with a mean of 12 grams and a standard deviation of 5 gram. The lower specification limit for the medication is 8.5 grams and the upper specification limit is 15 grams.

Q15. What is the process capability index (Cp or Cpk) for the medication production?

Q16. What is the probability that a dosage of this medication is either too light or too heavy?

Q17. Assuming that the process has been improved, and the mean is now 11.75 grams. What is the largest standard deviation of the weight in medication that would be consistent with a target of at least 75.8% probability of generating capable products?

Q18. To further improve the process, the pharmacy conducted a test batch and observed the following six weights: 11.72, 12.21, 11.35, 10.94, 10.88, 11.89 grams. Assume that the mean from Q17 is the grand average of past samples and the grand average range is 0.215. Compute the LCL and UCL for the X-bar chart and determine whether this batch is in control.

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G. The Stinking Rose, San Francisco

The Stinking Rose, one of San Francisco's most unique and entertaining dining experiences. Located in the heart of North Beach, San Francisco's renowned Little Italy, the garlic restaurant has become famous for celebrating the euphoria of garlic.

Q19. An employee at The Stinking Rose spends his time on the following: waiting for a customer order, taking the order, forwarding the order to the kitchen, waiting for the kitchen to confirm the order, bringing the food to the customer, serving the customer, and collecting the payment. Which of these time commitments are waste, and which are value-added work?

Q20. A supplier of garlic will charge the restaurant $0.4 per kg if the restaurant purchases in full truck quantities. A full truck of garlic is 15,000 kgs. Annual demand for garlic is 40,000 kgs. The restaurant assumes the annual holding cost is 25% and the fixed cost associated with each order is $50. Assuming the restaurant orders one full truck load at a time (15,000 kgs), what inventory cost (holding and ordering) would they occur each year? (Do not include purchasing costs.)

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The Stinking Rose's owner is expanding their restaurant empire. Planning is underway for a new restaurant in Downtown Berkeley. One important decision is how many parking spaces the restaurant should have. Each additional parking space costs $10,000 to build due to the cost of land and concrete. The company uses an opportunity cost of capital of 20% per year. The demand for parking spaces during a typical lunch hour on weekdays has a Normal distribution with mean = 50 and standard deviation = 20.

You may assume that each parking space can be used by only one group of customers arriving together in a car during each lunch hour, and that there are 250 weekdays in a year. The restaurant is very quiet on evenings and weekends, so parking is never a problem at those times. If customers cannot find a parking space, they will simply drive to the next fast-food restaurant. The profit from a typical group of customers arriving in a car is about $10.

Q21. What is the critical ratio for determining if an additional parking space makes sense?

Q22. How many parking spaces should be built?

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Q23. Which of the following statements are true? Circle all that are correct:

Everything else being equal…

A. Higher work-in-process inventory implies a higher flow time

B. Higher work-in-process inventory implies a higher cycle time

C. Higher work-in-process inventory implies a higher labor content

D. Higher work-in-process inventory implies a higher idle time

E. Higher work-in-process inventory implies a higher inventory turn

F. None of the above.

Q24. If a process is demand-constrained, then adding capacity to the bottleneck is likely to have the following impact:

A) The flow rate will increase
B) Utilization of the bottleneck will increase
C) Both inventory turns and days-of-supply will increase
D) All of the above
E) None of the above

Table of Control Chart Constants

	X-bar Chart Constants	for sigma estimate	R Chart Constants		S Chart Constants	
Sample Size = m	A_2	A_3	d_2	D_3	D_4	B_3	B_4
2	1.880	2.659	1.128	0	3.267	0	3.267
3	1.023	1.954	1.693	0	2.574	0	2.568
4	0.729	1.628	2.059	0	2.282	0	2.266
5	0.577	1.427	2.326	0	2.114	0	2.089
6	0.483	1.287	2.534	0	2.004	0.030	1.970
7	0.419	1.182	2.704	0.076	1.924	0.118	1.882
8	0.373	1.099	2.847	0.136	1.864	0.185	1.815
9	0.337	1.032	2.970	0.184	1.816	0.239	1.761
10	0.308	0.975	3.078	0.223	1.777	0.284	1.716
11	0.285	0.927	3.173	0.256	1.744	0.321	1.679
12	0.266	0.886	3.258	0.283	1.717	0.354	1.646
13	0.249	0.850	3.336	0.307	1.693	0.382	1.618
14	0.235	0.817	3.407	0.328	1.672	0.406	1.594
15	0.223	0.789	3.472	0.347	1.653	0.428	1.572
16	0.212	0.763	3.532	0.363	1.637	0.448	1.552
17	0.203	0.739	3.588	0.378	1.622	0.466	1.534
18	0.194	0.718	3.640	0.391	1.608	0.482	1.518
19	0.187	0.698	3.689	0.403	1.597	0.497	1.503
20	0.180	0.680	3.735	0.415	1.585	0.510	1.490
21	0.173	0.663	3.778	0.425	1.575	0.523	1.477
22	0.167	0.647	3.819	0.434	1.566	0.534	1.466
23	0.162	0.633	3.858	0.443	1.557	0.545	1.455
24	0.157	0.619	3.895	0.451	1.548	0.555	1.445
25	0.153	0.606	3.931	0.459	1.541	0.565	1.435

Control chart constants for X-bar, R, S, Individuals (called "X" or "I" charts), and MR (Moving Range) Charts.

NOTES: To construct the "X" and "MR" charts (these are companions) we compute the Moving Ranges as:

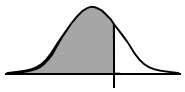
R_2 = range of 1st and 2nd observations, R_3 = range of 2nd and 3rd observations, R_4 = range of 3rd and 4th observations, etc. with the "average" moving range or "MR-bar" being the average of these ranges with the "sample size" for each of these ranges being n = 2 since each is based on consecutive observations ... this should provide an estimated standard deviation (needed for the "I" chart) of

σ = (MR-bar)/d_2 where the value of d_2 is based on, as just stated, m = 2.

Similarly, the UCL and LCL for the MR chart will be: UCL = D_4(MR-bar) and LCL = D_3(MR-bar)

but, since D_3 = 0 when n = 0 (or, more accurately, is "not applicable") there will be no LCL for the MR chart, just a UCL.

Standard Normal Probabilities



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
-3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
-3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
-3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
-3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
-2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
-2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
-2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
-2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
-2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
-2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
-2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
-2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
-2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
-2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
-1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
-1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
-1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
-1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
-1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
-1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
-1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
-1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
-1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
-0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
-0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
-0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
-0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
-0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
-0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
-0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
-0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
-0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998