

UGBA 141

Discussion 13

Agenda: Final Exam Review II

**See also Discussion 12 (Final Exam Review I)
& Lecture 23 (Final Flash Review)**

April 29, 2022
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Reminder

- HW4, HW5, Practice final solutions are available for pick up at front desk
- Please kindly complete the **course evaluation** at <https://course-evaluations.berkeley.edu/> by Sunday 11:59PM if you haven't already. We would really appreciate your feedback! 🙏
- **Final Office Hours** (All Virtual <https://bit.ly/ugba141sp22>)
 - Monday 5/2, 2-3PM with Park
 - Tuesday 5/3, 1-2PM with Hansheng
 - Wednesday 5/4, 4-5PM with Park
 - Friday 5/6, 2-3PM with Hansheng
 - Saturday 5/7, 10-11PM with Park
 - Sunday 5/8, 6-8PM with Hansheng
 - *Utilize our Discord server for Q&A!*

Final Information 5/11 3-6pm

32 Q's (35 pts): mix of quantitative and qualitative, integrative topics

- **SCM** bullwhip effect, quick response ([Obermeyer](#)), contracts
- **Queue** Little's law, waiting time, throughput losses, pooling, psychology
- **Strategy** revenue management, product management ([IDEO](#))
- **Emerging** transparency ([Tessei](#)), knowledge sharing ([Danone](#)), e-commerce ([Amazon](#)), network effects, future of work ([Google](#))
- **Integrative** process analysis, newsvendor, risk pooling
- **Skip** quality, EOQ/QR/PT, sustainability, cases before Tessei

One cheat sheet of an 8.5" x 11" paper + basic calculator

(Key formulas and tables of standard normal CDF/Inventory/Loss/Erlang will be provided)

Wednesday: Final Flash Review + Friday: Final Review #2 by GSI

Practice: lectures, discussions, HWs, practice exam, optional textbooks

SCM: Knowledge Map

	Bullwhip Effects	Quick Response	Contracts
Concepts & Takeaways	Information distortion; Reactive and overactive ordering; Trade promotions; Shortage gaming; Amplification of variability;	Made-to-stock vs made-to-order; Speculative vs reactive capacity; Quantify + reduce + avoid + hedge against uncertainty;	Buy-back contracts; Buy-back profit; Optimal buy-back price; Vertical integration; Double marginalization;
Cases	-	Sport Obermeyer	-
Question Practiced	Practice final Q20, Q31, Q32; Final flash review 0.07; Final flash review Strategy 0.09;	HW4 Q1-4; DIS9 Q1-5; Practice final Q21-23, Q30; Final flash review SCM 0.12, SCM 0.17;	HW4 Q5-8; DIS9 Q6-8; Practice final Q16-19; Final flash review SCM 0.09, SCM 0.15;
LEC Slides	SCM-II	SCM-III	SCM-III

Disclaimer: These tables serve as a “map” for navigating the world of UGBA 141. Please reread the LEC slides to refresh your understanding. Also FYI, some lecture/discussion videos are available in the Media folder on bcourses.

Queue: Knowledge Map

	Little's law	Waiting Time	Loss Systems	Pooling & Psychology
Concepts & Takeaways	<p>Average inventory (I) = average flow rate (R) * average flow time (T);</p> <p>Coefficients of variation; (Implied) utilization; Idle time;</p>	<p>Waiting time = time in queue;</p> <p>Time in system = time in queue + processing time;</p> <p>Special case Poisson/Exponential;</p> <p>Number of people in queue/system;</p>	<p>Probability that all resources are busy; Erlang loss table; Variability leads to waiting times although utilization < 1;</p>	<p>Parallel vs Pooled; Pooling reduces # waiting not # in service; Psychology of supplier and customer (interpretation and feeling); Economics of scale; Stability;</p>
Question Practiced	<p>HW5 Q1, Q2, Q5-7;</p> <p>DIS10 Q1-2;</p> <p>Practice final Q5-6, Q11, Q32;</p> <p>Final flash review Queue 0.07, Queue 0.12, Queue 0.15;</p>	<p>HW5 Q3, Q5-7;</p> <p>DIS11 Q1-4;</p> <p>Practice final Q7-10, Q12;</p>	<p>HW5 Q4;</p> <p>DIS 11 Q5-6;</p> <p>Practice final Q14-15;</p> <p>Final flash review Queue 0.17;</p>	<p>Practice final Q2, Q13, Q32;</p> <p>Final flash review Queue 0.09;</p>
LEC Slides	Emerging-V, Queue-I	Queue-II	Queue-II	Queue-III

Practice Problem

Customers send e-mails to a help desk of an online retailer every 2 minutes, on average, and the standard deviation of the interarrival time is also 2 minutes. The online retailer has three employees answering e-mails. It takes on average 4 minutes to write a response e-mail. The standard deviation of the processing times is 2 minutes.

Q1. Estimate the average number of customer wait before being served.

Q2. How many e-mails would there be, on average, that have been submitted to the online retailer but not yet answered?

Solution.

$$\text{Q1. } CV_a = \frac{2}{2} = 1, CV_p = \frac{2}{4} = 0.5, m = 3$$

$$\text{Utilization } \frac{p}{am} = \frac{4}{2 \times 3} = 0.6667$$

$$T_q = \left(\frac{4}{3}\right) \times \left(\frac{0.6667^{\sqrt{2(3+1)}-1}}{1-0.6667}\right) \times \left(\frac{1^2 + 0.5^2}{2}\right) = 1.19$$

Average # customers wait before being served = inventory in queue.

By Little's law, inventory in queue =

$$T_q \times \frac{1}{a} = 1.19 \times \frac{1}{2} = 0.595.$$

Q2. # emails submitted but not yet answered = inventory in the system

= inventory in the queue + inventory in the system

$$= 0.595 + p \times \frac{1}{a} = 0.595 + 4 \times \frac{1}{2} = 2.595$$

Emerging: Knowledge Map

	Transparency	Knowledge Sharing	E-Commerce	Network Effects	Future of Work
Concepts & Takeaways	Measures to improve transparency; Advantages and disadvantages for both customers and employees;	Codification vs personalization; Networking attitude; Knowledge management	Slow/fast-moving items; Operational capabilities; Centralized inventory + risk pooling;	Platform business models to leverage network effects; Value from 3 sources; One-sided vs multi-sided;	Automation (complementarity + new work); Gig economy; Value flexibility; Risk of disintermediation; Managing hybrid workforce; Worker turnover; Multihoming;
Cases	Tessei	Danone	Amazon	-	Google
Question Practiced	Practice final Q3; Final flash review Emerging 0.07, Emerging 0.09;	Final flash review Strategy 0.12;	Practice final Q28; Final flash review Emerging 0.15;	Practice final Q4; Final flash review Emerging 0.17;	Practice final Q1; Final flash review Emerging 0.12;
LEC Slides	Emerging-II	SCM-II	Emerging-IV	Emerging-V	Emerging-V

Strategy: Knowledge Map

	Revenue Management	Product Management
Concepts & Takeaways	(Optimal) protection levels; (Optimal) overbooking;	Design thinking = human-centered service design process; Process transparency; Customer transparency;
Cases	-	IDEO
Question Practiced	HW5 Q8-10; DIS 12 Q1-2, Q3-4; Practice final Q24-27, Q32; Final flash review Strategy 0.15, Strategy 0.17;	Practice final Q29; Final flash review Strategy 0.07;
LEC Slides	Strategy-I	Strategy-II

Some (Potentially Confusing) Concepts

- How busy is a server in a queueing system? **Utilization** versus **Throughput loss**
 - Utilization: what fraction of servers are busy on average
 - Definition: $\frac{p}{am}$
 - Throughput loss: probability that *all* servers are busy
 - Definition: $P_m(r)$, $r = \frac{p}{a}$
 - Read Erlang loss table to find the value for given m and r

Some (Potentially Confusing) Concepts

- **Lost sales** versus **Leftover inventory**
 - Lost sales: demand is larger than inventory
 - Leftover inventory: inventory is larger than demand
 - Note: Inventory = order quantity when there is no initial inventory
 - Simple illustrative example: assume order quantity = 500
 - ▶ When demand is 200, lost sales = 0, leftover inventory = 300
 - ▶ When demand is 600, lost sales = 100, leftover inventory = 0
- For **random** demand with Normal distribution
 - Expected lost sales = $\sigma L(z)$
 - Expected leftover inventory = $\sigma I(z)$
 - z is z-score, and $L(z)$, $I(z)$ read from Standard Normal Inventory Loss Table

Some (Potentially Confusing) Concepts

- Critical ratio, z-score, service level
- Backward computation (in Newsvendor)
 1. Compute critical ratio $= \frac{G}{G + L}$
 2. Find z-score z based on critical ratio by reading standard normal table
 3. Compute optimal quantity $Q^* = \mu + z\sigma$
- Forward computation
 1. Start with a given order quantity Q
 2. Compute z-score by normalizing Q , $z = \frac{Q - \mu}{\sigma}$
 3. Get service level (probability that $D \leq Q$) based on z by reading standard normal table. In other cases, can calculate the expected lost sales / leftover inventory from standard normal inventory/loss table.

Thank you!