



يوم : 2025/01/15

امتحان الدورة العادية في مقياس بحوث العمليات 01

التمرين الأول: (04 نقاط)

مصنع به أربعة آلات وتبحث إدارة المؤسسة عن كيفية تعيين أربعة عمال لتلك الآلات، ويمثل الجدول التالي تكاليف تشغيل كل آلة من قبل كل عامل (الوحدة هي 1000 دج).

الآلة \ العامل	M 1	M 2	M 3	M 4
T 1	1	5	6	2
T 2	3	1	9	7
T 3	7	9	2	1
T 4	9	7	3	3

المطلوب: حدد أفضل تخصيص للآلات حتى يتم تشغيلها بأقل تكلفة ممكنة، ثم أحسب التكلفة الاجمالية للآلات.

التمرين الثاني: (10 نقاط)

يمثل الجدول التالي النشاطات الفرعية لمشروع ما والأوقات الثلاثة (بالأسابيع) الخاصة بكل نشاط منها:

النشاط	A	B	C	D	E	F	G	H	I	J	K	L
النشاط السابق	--	A	A	A	C	C	C D	E F G	B H	E F G	I J	E F G
الوقت المتشائم	8	17	18	11	17	10	8	15	20	10	13	10
الوقت المتفائل	2	5	6	5	5	4	2	3	8	4	7	4
الوقت الأكثر توقعا	5	8	7,5	5	8	5,5	6,5	9	11	7	7	4

المطلوب:

- حساب الوقت المتوقع والانحراف المعياري والتباين لكل أنشطة المشروع؛
- رسم الشبكة الخاصة بالمشروع؛
- ايجاد المسار الحرج وبيان النشاطات الحرجة والنشاطات غير الحرجة؛
- حساب البداية المبكرة، البداية المتأخرة، النهاية المبكرة، النهاية المتأخرة والوقت الفائض لكل نشاط؛
- إذا تأخر زمن النشاط B بـ 10 أسابيع، بكم سيتأخر زمن المشروع ككل؛
- إذا تأخر زمن النشاط K بـ 3 أسابيع، بكم سيتأخر زمن المشروع ككل؛
- إذا تأخر زمن النشاط D بـ 7 أسابيع، بكم سيتأخر زمن المشروع ككل؛
- حساب احتمال اكمال المشروع في مدة: 53 اسبوع، 55 أسبوع و 57 أسبوع.

التمرين الثالث: (06 نقاط)

اليك النموذج التالي.

$$\text{Max : } Z = 10X_1 + 15X_2$$

$$\begin{cases} 2X_1 + 4X_2 \leq 25 \\ S/c \end{cases}$$

$$X_1 \geq 0; X_2 \geq 0 \quad X_1; X_2 \text{ صحيحة}$$

المطلوب: حل النموذج بالطريقة البيانية؛

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5159	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7854
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8804	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319

أ.د. محمد رضا بوسنة

بالتوفيق



الإجابة النموذجية لامتحان الدورة العادية في مقياس بحوث العمليات 01

العلامة	التمرين الاول																													
3	1 تحديد أفضل تخصيص للألات حتى يتم تشغيلها بأقل تكلفة ممكنة																													
	<table><tr><th>الآلة \ العامل</th><th>M 1</th><th>M 2</th><th>M 3</th><th>M 4</th></tr><tr><td>T 1</td><td>0</td><td>4</td><td>5</td><td>1</td></tr><tr><td>T 2</td><td>2</td><td>0</td><td>8</td><td>6</td></tr><tr><td>T 3</td><td>6</td><td>8</td><td>1</td><td>0</td></tr><tr><td>T 4</td><td>6</td><td>4</td><td>0</td><td>0</td></tr></table>					الآلة \ العامل	M 1	M 2	M 3	M 4	T 1	0	4	5	1	T 2	2	0	8	6	T 3	6	8	1	0	T 4	6	4	0	0
	الآلة \ العامل	M 1	M 2	M 3	M 4																									
	T 1	0	4	5	1																									
	T 2	2	0	8	6																									
	T 3	6	8	1	0																									
T 4	6	4	0	0																										
حساب التكلفة الاجمالية للألات																														
1 دج CT=1000+1000+1000+3000 = 6000																														
4	المجموع																													

النقاط													التمرين الثاني
1.5	L	K	J	I	H	G	F	E	D	C	B	A	النشاط
	5	8	7	12	9	6	6	9	6	9	9	5	الوقت المتوقع
	1	1	1	2	2	1	1	2	1	2	2	1	الانحراف المعياري
	1	1	1	4	4	1	1	4	1	4	4	1	التباين
2	رسم الشبكة الخاصة بالمشروع؛												
	<pre>graph LR; Debut[Debut] --> A((A)); A --> B((B)); A --> C((C)); A --> D((D)); C --> F((F)); C --> E((E)); C --> G((G)); D --> G; F -.- E; E --> DUMMY[DUMMY]; G -.- DUMMY; DUMMY --> H((H)); DUMMY --> J((J)); DUMMY --> L((L)); H --> I((I)); I --> K((K)); J --> K; L -.- K; K --> Fin[Fin]; style Debut fill:#fff,stroke:#000,stroke-width:1px; style Fin fill:#fff,stroke:#000,stroke-width:1px; style A fill:#fff,stroke:#000,stroke-width:1px; style B fill:#fff,stroke:#000,stroke-width:1px; style C fill:#fff,stroke:#000,stroke-width:1px; style D fill:#fff,stroke:#000,stroke-width:1px; style E fill:#fff,stroke:#000,stroke-width:1px; style F fill:#fff,stroke:#000,stroke-width:1px; style G fill:#fff,stroke:#000,stroke-width:1px; style H fill:#fff,stroke:#000,stroke-width:1px; style I fill:#fff,stroke:#000,stroke-width:1px; style J fill:#fff,stroke:#000,stroke-width:1px; style K fill:#fff,stroke:#000,stroke-width:1px; style L fill:#fff,stroke:#000,stroke-width:1px; style DUMMY fill:#fff,stroke:#000,stroke-width:1px; 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3	• إيجاد المسار الحرج وبيان النشاطات الحرجة والنشاطات غير الحرجة؛ المسار الحرج محدد في الشكل بالأسهم بلون أحمر. وبقية الأنشطة هي أنشطة غير حرجة، وطول المسار الحرج هو 52 أسبوع.	1.5																																																																																											
2	حساب البداية المبكرة، البداية المتأخرة، النهاية المبكرة، النهاية المتأخرة والوقت الفائض لكل نشاط																																																																																												
	<table><tr><th>النشاط</th><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th><th>I</th><th>J</th><th>K</th><th>L</th></tr><tr><td>الوقت المتوقع</td><td>5</td><td>9</td><td>9</td><td>6</td><td>9</td><td>6</td><td>6</td><td>9</td><td>12</td><td>7</td><td>8</td><td>5</td></tr><tr><td>البداية المبكرة</td><td>0</td><td>5</td><td>5</td><td>5</td><td>14</td><td>14</td><td>14</td><td>23</td><td>32</td><td>23</td><td>44</td><td>23</td></tr><tr><td>البداية المتأخرة</td><td>0</td><td>23</td><td>5</td><td>11</td><td>14</td><td>17</td><td>17</td><td>23</td><td>32</td><td>37</td><td>44</td><td>47</td></tr><tr><td>النهاية المبكرة</td><td>5</td><td>14</td><td>14</td><td>11</td><td>23</td><td>20</td><td>20</td><td>32</td><td>44</td><td>30</td><td>52</td><td>28</td></tr><tr><td>النهاية المتأخرة</td><td>5</td><td>32</td><td>14</td><td>17</td><td>23</td><td>23</td><td>23</td><td>32</td><td>44</td><td>44</td><td>52</td><td>52</td></tr><tr><td>الفائض</td><td>0</td><td>18</td><td>0</td><td>6</td><td>0</td><td>3</td><td>3</td><td>0</td><td>0</td><td>14</td><td>0</td><td>24</td></tr></table>	النشاط	A	B	C	D	E	F	G	H	I	J	K	L	الوقت المتوقع	5	9	9	6	9	6	6	9	12	7	8	5	البداية المبكرة	0	5	5	5	14	14	14	23	32	23	44	23	البداية المتأخرة	0	23	5	11	14	17	17	23	32	37	44	47	النهاية المبكرة	5	14	14	11	23	20	20	32	44	30	52	28	النهاية المتأخرة	5	32	14	17	23	23	23	32	44	44	52	52	الفائض	0	18	0	6	0	3	3	0	0	14	0	24	
	النشاط	A	B	C	D	E	F	G	H	I	J	K	L																																																																																
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الفائض	0	18	0	6	0	3	3	0	0	14	0	24																																																																																	
إذا تأخر زمن النشاط B بـ 10 أسابيع، لا يحدث أي تأخر في زمن المشروع ككل	0.5																																																																																												
إذا تأخر زمن النشاط K بـ 3 أسابيع، فإن زمن المشروع ككل سيتأخر بـ 3 أسابيع	0.5																																																																																												
إذا تأخر زمن النشاط D بـ 7 أسابيع، فإن زمن المشروع ككل سيتأخر بـ 1 أسبوع.	0.5																																																																																												
1.5	• حساب احتمال اكمال المشروع في مدة 53 أسبوع؛ $Z = \frac{53 - 52}{4.24} = \frac{1}{4.24} = 0.23$ $\Rightarrow p(z = 0.23) = 0.5910$ وعليه فإن الاحتمال هو 59,10%.																																																																																												
	• حساب احتمال اكمال المشروع في مدة 55 أسبوع؛ $Z = \frac{55 - 52}{4.24} = \frac{3}{4.24} = 0.70$ $\Rightarrow p(z = 0.70) = 0.7580$ وعليه فإن الاحتمال هو 75,80%.																																																																																												
	• حساب احتمال اكمال المشروع في مدة 57 أسبوع؛ $Z = \frac{57 - 52}{4.24} = \frac{5}{4.24} = 1.17$ $\Rightarrow p(z = 1.17) = 0.8790$ وعليه فإن الاحتمال هو 87,90%.																																																																																												
	المجموع	10																																																																																											

حل النموذج بالطريقة البيانية؛

2

$$\begin{aligned} \text{Max : } Z &= 10X_1 + 15X_2 \\ \text{S /c } \begin{cases} 2X_1 + 4X_2 \leq 25 \\ X_1 \geq 0; X_2 \geq 0 \end{cases} \\ X_1, X_2 &\text{ صحيحة} \end{aligned}$$

$$\begin{aligned} X_1 &= 12.5, X_2 = 0, Z = 125. \\ 12 &< X_1 < 13. \end{aligned}$$

2

$$\begin{aligned} \text{Max : } Z &= 10X_1 + 15X_2 \\ \text{S /c } \begin{cases} 2X_1 + 4X_2 \leq 25 \\ X_1 \leq 12 \\ X_1 \geq 0; X_2 \geq 0 \end{cases} \\ X_1, X_2 &\text{ صحيحة} \end{aligned}$$

$$\begin{aligned} X_1 &= 12.5, X_2 = 0.25, \\ Z &= 123.75 \\ 0 &< X_2 < 1. \end{aligned}$$

$$\begin{aligned} \text{Max : } Z &= 10X_1 + 15X_2 \\ \text{S /c } \begin{cases} 2X_1 + 4X_2 \leq 25 \\ X_1 \geq 13 \\ X_1 \geq 0; X_2 \geq 0 \end{cases} \\ X_1, X_2 &\text{ صحيحة} \end{aligned}$$

لا يقبل حلول

الحل الأمثل

2

$$\begin{aligned} \text{Max : } Z &= 10X_1 + 15X_2 \\ \text{S /c } \begin{cases} 2X_1 + 4X_2 \leq 25 \\ X_1 \leq 12 \\ X_2 \leq 0 \\ X_1 \geq 0; X_2 \geq 0 \end{cases} \\ X_1, X_2 &\text{ صحيحة} \end{aligned}$$

$$X_1 = 12, X_2 = 0, Z = 120.$$

$$\begin{aligned} \text{Max : } Z &= 10X_1 + 15X_2 \\ \text{S /c } \begin{cases} 2X_1 + 4X_2 \leq 25 \\ X_1 \leq 12 \\ X_2 \geq 1 \\ X_1 \geq 0; X_2 \geq 0 \end{cases} \\ X_1, X_2 &\text{ صحيحة} \end{aligned}$$

$$\begin{aligned} X_1 &= 10.5, X_2 = 1, Z = 120. \\ 10 &< X_1 < 11. \end{aligned}$$